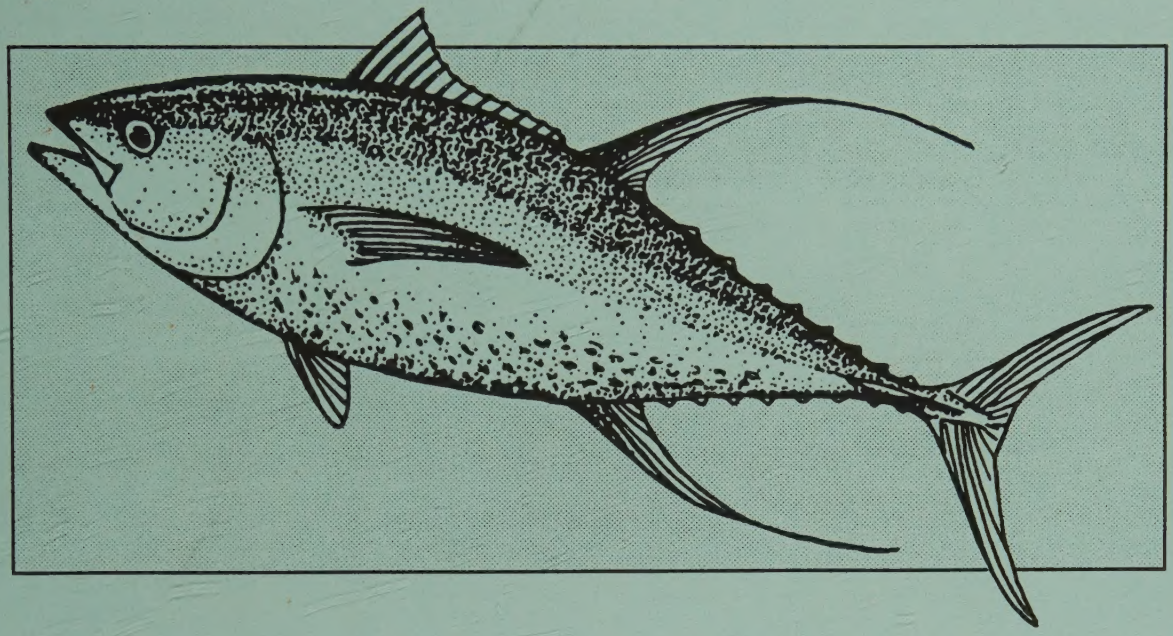
Library
NOAA, National Marine Fisheries Service
SWFC Honolulu Laboratory F/SWC2
2570 Dole Street
Honolulu, HI 96822-2396

Pelagic Fisheries of the Western Pacific Region

1991 Annual Report



August 1992

Prepared by the Pelagics Plan Team and Council Staff

for the

Western Pacific Regional Fishery Management Council
1164 Bishop Street #1405, Honolulu, Hawaii 96813
Telephone (808) 523-1368, Fax (808) 526-0824

WPFMC
Pelagics
Ann.
Rep.
1991

A report of the Western Pacific Regional Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award No. NA17FC0062-02.

NMFS Honolulu Library
00000000005742

Pelagic Fisheries of the Western Pacific Region

1991 Annual Report

August 1992

Western Pacific Regional Fishery Management Council
Honolulu, Hawaii

Contents

page

Introduction 1
Background 1
Report Content 2
Report Appraisal 3
Plan Team Members 4

Summary 5

Issues 9

Recommendations 10

Research 11

Plan Administration and Enforcement 20
Administrative Activities 20
Enforcement Activities 22
Habitat Issues 23

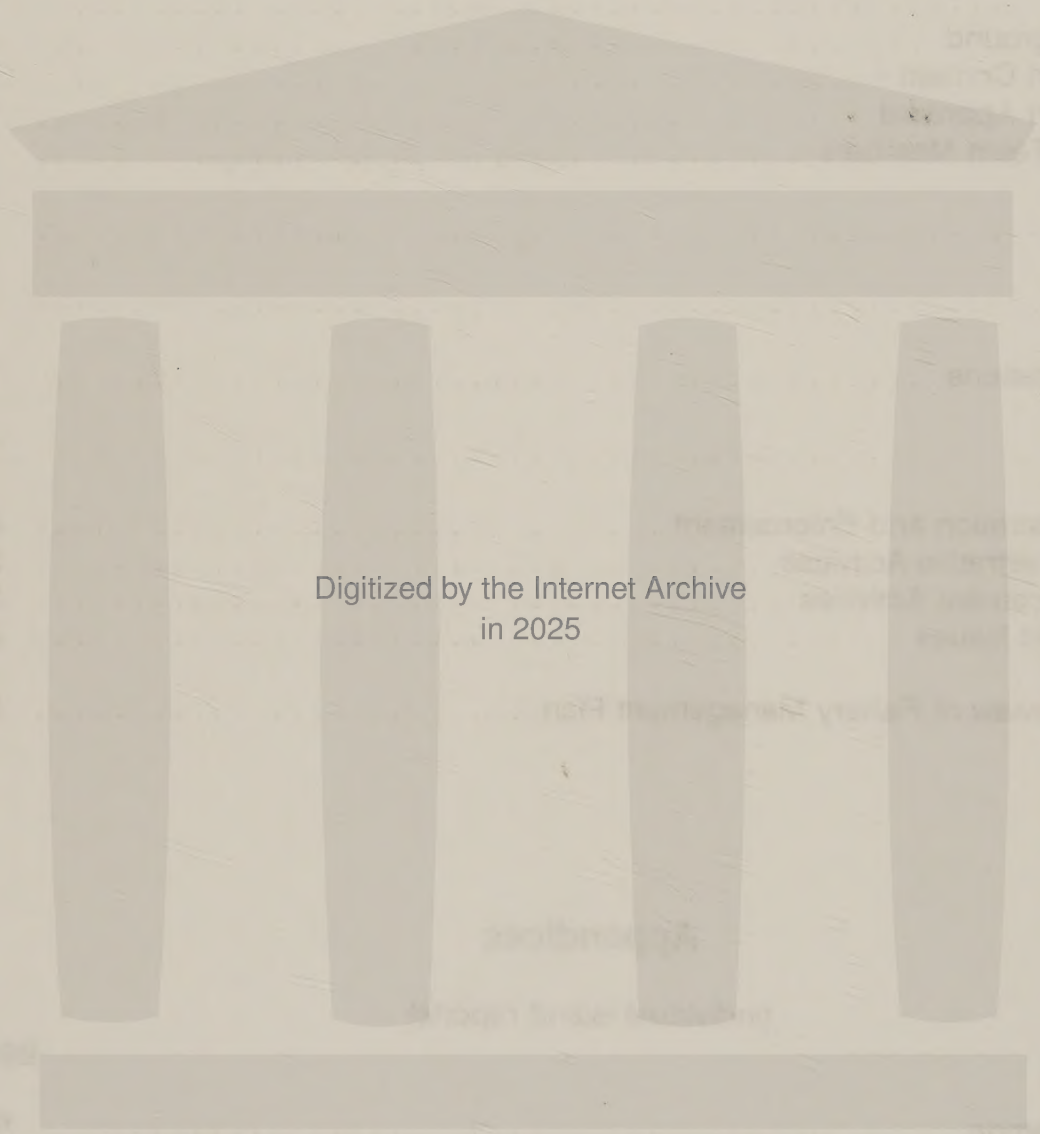
Five-Year Review of Fishery Management Plan 23

Appendices

(individual island reports)

page

American Samoa A-1
Guam B-1
Hawaii - Part A (NMFS and State of Hawaii, includes all gear) C-1
Hawaii - Part B (State of Hawaii only, excludes longline data) D-1
Northern Mariana Islands E-1



Digitized by the Internet Archive
in 2025

https://archive.org/details/pelagic-fisheries-western-pacific-region-annual-report_1991

Introduction

Background

The Fishery Management Plan (FMP) for the Pelagic Fisheries of the Western Pacific Region was implemented by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) on March 23, 1987. The Western Pacific Regional Fishery Management Council (WPRFMC or Council) developed the FMP to manage the pelagic resources covered by the Magnuson Fishery Conservation and Management Act of 1976 and occurring in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii, the Northern Mariana Islands, and other US possessions in the Western Pacific Region (i.e., Johnston Atoll, Kingman Reef & Palmyra Island, Jarvis Island, Howland and Baker Islands, and Wake Island).

The objectives of the Pelagics FMP were revised in 1991 (Amendment 1). The abridged objectives are to:

- Manage fisheries for management unit species to achieve optimum yield.
- Promote domestic harvest of, and domestic fishery values associated with, pelagic management unit species, or PMUS (e.g., by enhancing the opportunities for satisfying recreational fishing experience, continuation of traditional fishing practices, and domestic commercial fishermen to engage in profitable operations).
- Diminish gear conflicts in the EEZ, particularly in areas of concentrated domestic fishing.
- Improve the statistical base for conducting better stock assessments and fishery evaluations.
- Promote formation of regional/international arrangements for assessing and conserving PMUS and tunas throughout their range.
- Preclude waste of PMUS associated with longline, purse seine, pole-and-line or other fishing operations.
- To promote domestic marketing of PMUS in American Samoa, Guam and Hawaii.

The pelagic management unit species (PMUS) are[1]:

Common Name	Scientific Name
Mahimahi (dolphin fish)	*Coryphaena hippurus*
Pompano dolphin fish	*C. equiselis*
Wahoo	*Acanthocybium solandri*
Indo-Pacific blue marlin	*Makaira mazara*
Black marlin	*M. indica*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*T. angustirostris*
Swordfish (broadbill)	*Xiphias gladius*
Requiem sharks (oceanic species)	family Carcharhinidae
Thresher sharks (oceanic species)	family Alopiidae
Mackerel sharks (oceanic species)	family Lamnidae
Hammerhead sharks (oceanic species)	family Sphyrnidae

The PMUS are caught with trolling gear, tuna and swordfish longline gear, and handline gear. They are caught in oceanic as well as insular pelagic waters. Most of these species are considered to be epipelagic because they occupy the upper most layers of the pelagic zone. All are high-level predators in the trophic sense. Pelagic fisheries for PMUS and tunas are important, if not the most important, components of most Pacific island fisheries.

The FMP requires the Council's Pelagic Plan Team (Team) to prepare an annual report on the status of the pelagic fisheries taking place in each of the island areas served by the Council (American Samoa, Guam, Hawaii, and Northern Mariana Islands), evaluate the effectiveness of the FMP in meeting its goals and objectives, and make recommendations for future management and administrative action.

Report Content

This report contains fishery performance data from each of the four island groups through 1990 (see Appendices), interpretations of trends or important events occurring in the fisheries, and recommendations. Because this is the fifth annual report, it must also constitute a five-year review as required by the FMP. Sections on FMP administration and enforcement activities are also included, as is a report on habitat issues.

---

[1] The Magnuson Act was amended to allow the inclusion of tunas in US fishery management authority as of January 1992. In the Pacific, tuna management is the responsibility of the regional fishery management councils. The WPRFMC has submitted, for Secretarial review and approval, an FMP amendment that will include tunas and related species caught in the region.

This report was prepared using reports submitted by the following agencies:

- Territory of American Samoa, Department of Marine and Wildlife Resources
- Territory of Guam, Division of Aquatic and Wildlife Resources
- State of Hawaii's Division of Aquatic Resources
- Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife
- National Marine Fisheries Service, Southwest Region (including Southwest Fisheries Science Center Honolulu Laboratory, Pacific Area Office, and Office of Enforcement)
- US Coast Guard District 14

As was the case for the last couple of years, the Hawaii report (Appendices 3 and 4) is a combination of summaries from the State of Hawaii and the NMFS.

Report Appraisal

Report content has not changed significantly from last year. The reader should note that the Hawaii report contains 1990 and 1991 data, thus making it as current as the other island reports (for the first time). The State of Hawaii has made numerous improvements in the collection and processing of commercial catch reports to make this possible. The Team did not expand or improve on the use of fishery indicators this year.

Plan Team Members

American Samoa:

Mr. John McConnaughy
Ms. Bonnie Ponwith
Dept. of Marine & Wildlife Resources
P.O. Box 3730
Pago Pago, AS 96799
Tel: (684) 633-4456

Guam:

Mr. Robert Myers
Div. of Aquatic & Wildlife Resources
Guam Department of Agriculture
P.O. Box 2950
Agana, GU 96910
Tel: (671) 734-3944

Hawaii:

Dr. Robert Skillman, Chair
Dr. Christofer Boggs
Mr. David Hamm
Dr. Samuel Pooley
Dr. Jerry Wetherall
Honolulu Laboratory
National Marine Fisheries Service
2570 Dole St.
Honolulu, HI 96822
Tel: (808) 943-1221

Dr. Richard Brock
University of Hawaii Sea Grant
1000 Pope Rd.
Honolulu, HI 96822
Tel: (808) 956-8191

Dr. David Grobecker
GAIA Marine Institute
P.O. Box 2508
Kailua-Kona, HI 96745
Tel: (808) 325-6751

Mr. Walter Ikehara
Division of Aquatic Resources
Hawaii Dept. Land & Natural Resources
1151 Punchbowl Street #330
Honolulu, HI 96813
Tel: (808) 587-0096

Mr. Gordon Leslie
RR1, Box 179
Captain Cook, HI 96704
Tel: (808) 328-9060

Northern Mariana Islands:

Mr. John Gourley
Dr. Terry Donaldson
Division of Fish & Wildlife
Department of National Resources
Saipan, MP 96950
Tel: (670) 322-9729

Annual Report Coordinator and Editor

Mr. Robert Harman
Western Pacific Regional Fishery
Management Council
1164 Bishop St. #1405
Honolulu, HI 96813
Tel: (808) 523-1368

Summary

1. The Council took several management actions in 1991 (see section on administrative activities for details). Amendment 2 requiring longline permits and reporting, Amendment 3 establishing Hawaiian monk seal area closures, and Amendment 4 establishing a longline moratorium were implemented during the year. An emergency action establishing longline area closures in the main Hawaiian Islands was also implemented, and Amendment 5 was drafted to replace the emergency action.

2. The Hawaii fishery for PMUS (with commercial landings of 15.7 million lb with an ex-vessel value of $28.9 million) was much larger than the fisheries for PMUS in the other island areas under the jurisdiction of the Council. In comparison, the Guam fishery landed the next largest quantity of PMUS (0.62 million lb, followed by the Northern Marianas and American Samoa fisheries with PMUS landings of 0.06 and 0.01 million lb, respectively. In contrast to all other management areas, Guam PMUS landings exceeded tuna landings (0.18 million lb) because of significantly different social and market preferences for mahimahi and wahoo, rather than tuna.

3. In American Samoa, none of the indicators showed any significant change in the status of the resources. While the non-commercial fishery increased somewhat, the commercial fishery continued to decline due largely to factors not related to the fishery. The third hurricane in as many years further reduced the number of vessels in the fishery, and shore-based occupations apparently proved to be more lucrative than fishing. Prices for PMUS have failed to keep up with inflation, while those for tunas have. Non-target (bycatch) landings from the longline fishery as well as imports from Western Samoa and Tonga have also impacted the fishing sector.

4. In Guam, none of the indicators showed any significant change in the status of the resources, and the pelagic fishery continued to expand, particularly the charter component. On the negative side, price and revenue per trip have failed to keep up with inflation due, at least in part, to the entry of tunas from foreign vessels through irregular marketing channels. Two domestic longline vessels are getting ready to fish in 1992. The marlin catch expanded due to the growth of the charterboat fleet. The average size of yellowfin tuna in the International Fishing Derby increased for the second year apparently reversing a decline starting in 1980.

5. In Hawaii, none of the indicators demonstrated any adverse change in the status of the resources. The moratorium has not resulted in any obvious beneficial change in the troll fishery. There has been a dramatic increase in

the catch rate of yellowfin tuna in the surface fisheries, but the average size declined substantially. Catch rates of mahimahi and skipjack tuna also set new highs. Swordfish is now the dominant species in the pelagic fishery. Landings of mahimahi have also expanded greatly. Over 40% of longline trips were outside the EEZ. Bycatch of blue marlin by longlines was still a major component of the total landings, but less so than previously.

6. In the Northern Mariana Islands, the pelagic fishery seems to be in good economic health although commercial effort has declined moderately since 1983. The charterboat industry is reportedly expanding rapidly due to the partially completed Smiling Cove development. Commercial landings for the last two years were down somewhat due to poor skipjack tuna seasons. A record catch of mahimahi was set in 1991.

7. The Hawaii landings in 1991 for all pelagic species (26.3 million lb) increased 41% over 1990, while the 1990 increase was 15% over 1989. For PMUS alone, the growth in estimated landings was 76% over 1990 (1990 was 68% over 1989, due almost entirely to increased landings of swordfish (up 129% in 1991 and 467% in 1990) and mahimahi (up 57% in 1991 and 88% in 1990). In fact, Hawaii landings decreased only for blue marlin, yellowfin tuna, and kawakawa. Guam landings of PMUS (0.72 million lb) increased by 84% in 1991, following a generally upward trend since 1980. Guam 1991 landings of all pelagics (.80 million lb) increased 44%. Landings of PMUS in the Northern Marianas increased 130% to 0.03 million lb, but skipjack tuna landings, the largest component of the landings in the Northern Marianas, declined again in 1991 representing a 57% decline since 1987. American Samoa PMUS landings increased 47% to 0.014 million lb, but the fishery is still suffering the effects of hurricane damage and competition from frozen fish imports.

8. In 1991, the Hawaii longline fleet landed 19.0 million lb of pelagic fish, maintaining a steady increase since 1987. As in the last couple of years, longliners caught most of the billfish landed in Hawaii, including nearly all of the swordfish and striped marlin, as well as half of the blue marlin. Roughly 70% the longline landings (approx. 12.8 million lb) were PMUS, compared with 4.9 million lb landed by the troll and handline fisheries. Hawaii's troll and handline fisheries increased their landings of pelagics in 1991 to 4.9 million lb but not enough to match the 1987 level. The only major species caught predominantly by troll and handline vessels were mahimahi and wahoo.

9. The Pelagic FMP was originally established because of concerns regarding foreign longline catches within the US 200-mile EEZ, which were highest in 1976 at 8.6 million lb, including 1.1 million lb of billfish. Domestic longline landings in 1991 both within and beyond the EEZ were 2.6 times greater than the foreign 1976 catch, with billfish alone totaling 12.9 million lb or 11.7 times greater.

10. The swordfish longline fishery in Hawaii was initiated in 1989 with landings estimated of 0.6 million lb, increasing to 3.4 million lb in 1990, and 9.6 million lb in 1991. The average size of swordfish dropped slightly in 1991, but remained above the 1987-89. Swordfish comprised the largest proportion of the total PMUS landings in Hawaii for the second consecutive year (62% in 1991 and 38% in 1990). Swordfish landings from other, non-longline gear are negligible.

11. In Hawaii, blue marlin landings declined again from a high in 1989, becoming the fourth-ranked among the PMUS. Guam landings declined only slightly, but enough to fall behind mahimahi and skipjack tuna. Marlin landings in the Northern Marianas (presumably blue marlin) declined slightly, but remained at near the average. In American Samoa, blue marlin landings increased to 2.4 times the 1990 landings.

12. The catch rate of blue marlin in the Hawaii troll fishery declined in 1990, but remained steady in 1991 at a level which was higher than a low abundance period from 1983-1987. In Guam, blue marlin catch per hour of trolling remained steady at the record high 1990 level, although catch rates have increased slowly since 1980. The catch rate of blue marlin in the American Samoa troll fishery increased to the second highest value since 1982. In the Northern Marianas, the catch rate declined again in 1991, but was no lower than in the period 1873-87.

13. The average size of blue marlin caught by the Hawaii longline fishery was smaller than troll/handline caught fish, for the fifth straight year. Both 1991 averages declined somewhat from the high value recorded in 1990. The average size of blue marlin in the Guam international derby declined again, setting a new record low.

14. Striped marlin landings ranked third among the PMUS in Hawaii (after swordfish and mahimahi), where it accounted for 10% of the commercial landings of PMUS. The 1991 landings of 1.5 million lb tied with the high recorded in 1989. Striped marlin is regarded as a secondary target species after bigeye tuna in the winter longline fishery. Troll and handline fisheries catch few striped marlin, and the species rarely appears in the domestic landings from other management areas.

15. Shortbill spearfish made up 3% of the PMUS landings in Hawaii and rarely appeared in the landings reported for other management areas. Black marlin and other miscellaneous billfish are rare in all fisheries.

16. Sailfish landings were insignificant in all management areas.

17. Mahimahi landings (2.2 million lb) made up 14% of the 1991 commercial PMUS landings in Hawaii, which was a 57% increase from 1990 and 340% from the low in 1988. The longline fishery accounted for 73% of the 1991 landings. The troll catch rate in Hawaii increased for the third consecutive year reaching a new high. In Guam, mahimahi landings increased 3-fold from 1990 to 401,700 lb, or 65% of PMUS landings, and setting a new record high. The trolling catch rate also increased dramatically, setting a new record high. Similarly in the Northern Marianas, mahimahi landings increased 2-fold from 1990 to 26,800 lb, or 91% of the PMUS landings, and set a new record level. The trolling catch rate also increased from 1990, and set a new record high. In American Samoa, mahimahi landings (1800 lb) declined for the third consecutive year but remained above the low in 1982.

18. Wahoo landings in Hawaii for 1991 (437,000 lb) increased 33% from 1990, equaled the 1987-91 average, and ranked fifth among the PMUS. The trolling catch rate data for Hawaii indicate that wahoo abundance has remained fairly steady since 1979. In Guam, wahoo landings (70,000 lb) were up slightly from 1990 and represented 11% of the PMUS landings, but remained within the range occurring since 1980. Catch rates followed a similar trend. In the Northern Marianas, wahoo landings (1200 lb) were down, setting a new record low. Landings for 1989-91 have been well below those for 1983-88. Catch rate followed a similar trend, suggesting that wahoo abundance may be down from earlier years. In American Samoa, wahoo landings (1000 lb) declined to the lowest level since 1982-83. Catch rate remained at the 1990 level and showed no trend.

19. Shark landings were generally small or unreported. There is little commercial or sport fishing interest in sharks compared to the other PMUS species. Finning of sharks does occur in the Hawaii fishery, but the magnitude of the harvest is not well documented.

20. Troll fisheries dominated the domestic fisheries in American Samoa, Guam and the Northern Marianas, in contrast to Hawaii where the longline sector caught more PMUS and tunas than the other sectors for the third consecutive year. Pelagic handline fishing has not yet become established in any American Pacific island fisheries other than Hawaii's.

21. In Hawaii, the inflation-adjusted ex-vessel revenue from the sale of pelagic species for the longline fishery has been increasing and has been increasing faster than landings. In contrast, revenue of the troll and handline fisheries has been decreasing and has not kept up with inflation, particularly in recent years. Thus, the longline fishery has a better economic status than the troll and handline fisheries. Likewise, the commercial surface fisheries in the other Council areas are generally not very healthy. In American Samoa and Guam, inflation-adjusted prices shows no trend with time, and inflation-adjusted

revenues show a declining trend with time for both PMUS and all pelagics combined. In the Marianas, 1991 inflation-adjusted price of PMUS decreased slightly, but prices in 1990 and 1991 were still above the level prices of the earlier years. However, inflation-adjusted revenues per trip showed a marked downward trend for all pelagic species although, PMUS revenues have increased in recent years.

22. Fishing effort for combined pelagic fisheries in Hawaii remained at a high level in 1991. The number of longline vessels increased from around 40 in 1983-87 to nearly 140 in 1990. Then, in 1991, the number declined to 111 as boats left the fishery and could not be replaced under the moratorium. The number of longline trips followed a similar trend except in 1991 when trips increased moderately. The number of trips by the troll fishery increased in 1990 and 1991, nearly reaching the high recorded in 1987. The number of trips taken by skipjack tuna baitboats reached a new low in 1990, and recovered only moderately in 1991. The number of handline trips decreased after 1987, until 1991 when they increased moderately. In Guam, the number of boats was down slightly in 1990 and 1991, but still remain above the long-term average. The number of trips and hours fished has been relatively steady for the last four years, but again continued above the long-term average. In American Samoa, the number of boats in the pelagic fishery has been declining since the high in 1986, but the number of trips and hours fished have shown much less of a decline and, indeed, increased in 1991. In the Northern Marianas, the number of fishermen landing any pelagic continued to decline, but the number of trips landing any pelagic increased in 1991 in contrast to a general downward trend. The number of trips landing just PMUS increased in 1991 but no trend is indicated.

23. In 1990, no permits to fish in the US EEZ of the Western Pacific region were requested by any foreign country. Foreign skipjack tuna bait boats and foreign or domestic tuna purse seiners were not subject to any permit or reporting requirements under the MFCMA in 1990; thus, data on these fisheries were lacking.

Issues

With the addition of tunas and related species to the FMP, and recent changes in the region's pelagic fisheries, the Team calls attention to the following issues that may well require Council action in the near future.

1. The region's pelagic fisheries harvest large adult fish generally having high commercial value, as well as smaller subadults generally of lower commercial value, but often high non-commercial value. Generally, the more inshore

surface gears (troll and handline; commercial or otherwise) take smaller sized individuals than offshore gear (mostly longlines) although the opposite seems to be true for blue marlin. Because a commercial pelagic handline fishery is now developing that specifically targets small yellowfin tuna found in association with seamounts and weather buoys located off the Hawaiian Islands, interest is intensifying in establishing minimum size limits for yellowfin and bigeye tunas.

Two concerns are being voiced. First, will a large harvest of subadult fish within the Hawaiian EEZ cause a decline in the harvest of large adults within our own fishery? If subadult fish in local waters are recruited into the fishery for adults, rather than migrating out of the EEZ to mix with fish from other sources or to move into other fisheries, then such a fishery will eventually have a measurable impact on the harvest of adult fish. Second, these small fish are reportedly so easy to catch that it is easy to (and with the addition of more boats, will become even easier) flood the local market, causing prices to fall. While consumers may benefit from lower prices, profit margins for fishing boats would decline, and business failures would increase.

2. Total catch estimates are needed to effectively manage the region's pelagic fisheries. Decreasing funds will make it even more difficult to implement programs to collect recreational and other non-commercial catch data on a regular basis (not necessarily annually). Also, with the addition of tunas to the FMP, the domestic purse seine fishery taking tunas near US possessions in the Pacific is likely one of the region's largest fisheries, even though harvest from the US EEZ are probably a small part of their total harvest. Although absolutely necessary for managing the region's fisheries, obtaining the purse seine data will probably be as politically difficult as getting the original FMP approved.

Recommendations

The Plan Team made several recommendations regarding Western Pacific pelagic fisheries management. These recommendations (and other findings and conclusions contained in the report) are the Team's alone, and do not necessarily reflect those of the Pelagics Advisory Panel, the Scientific and Statistical Committee (SSC), the Council, or the various organizations that employ the Team members.

1. Take the following steps to address the minimum size controversy:

    a. Conduct public meetings to address the need for minimum size regulations for pelagic species such as yellowfin and bigeye tuna;

encourage the fishing community to recommend mutually-acceptable minimum sizes.

b. Work with the State of Hawaii to implement State regulations using industry recommendation as a guide.

c. Perform yield-per-recruit assessments of yellowfin and bigeye tuna to determine the theoretical impacts on stock dynamics of fisheries harvesting small fish.

d. Examine in detail the catch rates and size data by subareas in Hawaii to address the claims that inshore fish are smaller and less abundant than before.

2. Continue efforts to implement a full-scale recreational fishing survey in Hawaii based on the pilot survey conducted on Oahu by the State of Hawaii (with Federal funding).

3. Continue efforts to obtain domestic purse seine data. The first priority is to obtain volume (weight of landings) and participation (number of boats). Detailed catch and effort data by precise locations will be needed to assess the status of stocks in collaboration with other researchers providing data from their national fisheries.

4. Encourage voluntary tagging and release of pelagic species, particularly small fish of little commercial or tournament value, by commercial and recreational fishermen.

5. When convenient, amend the pelagic management unit species to include pomfrets (manchon), oilfish (escolar), and moonfish (opah), and to exclude non-pelagic sharks (e.g., tiger and hammerheads).

6. Improve the coverage of sharks by state, territory, and federal data collection programs (including catch, effort and identification to species).

Research

This section summarizes some of the research related to western Pacific pelagic fisheries that was conducted by the NMFS in 1991.

1. Jerry A. Wetherall, Chief of Pelagic Resources Investigations, reported that the Honolulu Laboratory continued its research on high-seas driftnet fishing in the North

Pacific Transition Zone (NPTZ). Using data collected by scientific observers aboard the commercial driftnet fleets of Japan, Korea and Taiwan, provisional estimates of tuna and billfish catch and bycatch were computed. These were reported at international meetings in Canada and Japan, and to the WPRFMC. Final estimates of the driftnet catches of tunas, billfishes, mahimahi and other species of interest to the WPRFMC are being calculated, including observer data from the 1991 fishing season. Information on discard practices and shipboard processing and utilization of tunas, billfishes and other species is also being compiled and analyzed.

Because Japan, Korea, and Taiwan agreed to an international ban on high-seas driftnet fishing after December 31, 1992, the USA did not negotiate placement of observers during 1992. However, the Honolulu Laboratory research is expected to continue into the next fiscal year while numerous research projects are completed, and publications prepared. Studies are continuing on a range of topics, including the age, growth and trophic ecology of pomfrets and squids, the impacts of driftnet fisheries on tunas, billfishes and marine turtles, the pelagic ecology of marine turtles, and NPTZ community structure and ecosystem dynamics.

2. Robert A. Skillman, Leader of the Pelagic FMP Research Program, reports the completion of the first in a series of swordfish longline research cruises. The biology and ecology of swordfish were investigated during Leg I of NOAA Ship TOWNSEND CROMWELL cruise 91-01 (TC-159), from 4 January to 2 February 1991. This research is in response to the paucity of scientific information on the swordfish in the Pacific, and the growing need for information on the recently-established Hawaiian longline swordfish fishery, which has contributed to the great expansion of the longline fleet in the last two years. Longline operations were conducted over submerged banks windward of Necker Island, French Frigate Shoals and Gardner Pinnacles, as well as over seamounts north of Gardner Pinnacles and in the Musicians Seamounts.

Laboratory staff collected otoliths, dorsal and anal fin spines, and cephalic and caudal vertebrae for age and growth studies. Gonad samples and data were collected for the study of maturation. Cross-sections of bills and hypural plates were collected, and morphometric measurements were recorded (posterior edge of the eye orbit fork length, lower jaw fork length, tip of the bill fork length, several truss measurements, and body depth and half-girth at two different sites) for the study of stock structure. The latter data and weight measurements were collected to also facilitate converting size measurements taken from partially processed swordfish landed by commercial boats to more scientifically useable units. In addition, marking and tagging operations were conducted to further the research on age, growth, and stock structure. During the cruise, 10 swordfish, *Xiphias gladius*, and two striped marlin, *Tetrapturus audax*, were injected with oxytetracycline, tagged and released. Also tagged and released were four swordfish, one striped marlin, six bigeye tuna, *Thunnus obesus*, five yellowfin tuna, *Thunnus albacares*, and one mahimahi, *Coryphaena hippurus*, using tags provided by Fishery Biologist James Squire from the Pelagic Fisheries Resources Division of the La Jolla Laboratory.

Honolulu Laboratory staff also investigated swordfish habitat utilization by attaching time-depth recorders to the main line of the longline gear and using hook timers attached to individual hook dropper lines. In addition, temperature and salinity profiles in the area of the longline operations were determined by taking XBT and CTD casts and continuously recording surface thermosalinograph data. Information on currents was collected using an acoustic Doppler current profiler.

To supplement the research capabilities existing at the Honolulu Laboratory, collaboration was established with Barbara Block of the University of Chicago and Murray D. Dailey from California State University at Long Beach. Parasite specimens were collected from swordfish and other pelagic fishes by Patrick Frost, a graduate student from California State University at Long Beach. Research in this area was desirable because east coast fishermen entering Hawaii's fishery have reported that Pacific swordfish have a very high parasite load compared to Atlantic swordfish. For stock structure analysis, material rich in mtDNA was collected by John Finnerty, a graduate student, and Soo Young Kim, a laboratory technician, both from the University of Chicago. Similar tests have been conducted by Block on material collected in the Atlantic and Mediterranean. The mtdna-rich material collected was the heat exchanger organ located along the ocular nerve to the brain in swordfish. This material will also be used to further the physiological and developmental research that Block is conducting on this organ.

3. Samuel G. Pooley, Chief of the Fishery Management and Performance Investigations, reported on the following three projects.

A. "A Summary of Swordfish [*Xiphias gladius*] Longline Observations in Hawaii, July-October 1990" was recently completed by Robert A. Dollar, Russell Y. Ito, Kurt E. Kawamoto and Kevin C. Landgraf (SWFSC Administrative Report H-91-03).

Their research responded to the demand for information on a fishery that has experienced tremendous growth since its beginning in 1988 -- less than 50,000 lb of swordfish were landed in Hawaii in 1988; that amount increased to 650,000 lb in 1989, and probably exceeded 2.5 million lb (worth over $7.5 million) in 1990. The vast majority of the swordfish were landed as a fresh, headed and gutted product, which was then transhipped to the US mainland, particularly the east coast.

Little was known about the fishery at the time, and by early 1990, it became apparent that the potential existed for interactions between the expanding swordfish longline fishery and various protected species, i.e, turtles, seabirds and particularly Hawaiian monk seals, *Monachus schauinslandi*. Therefore, the Honolulu Laboratory, with fiscal assistance from the NMFS Southwest Region, fielded six observers aboard swordfish longline vessels fishing in Hawaiian waters in the summer and early fall of 1990. These vessel participated on a

voluntary basis because there was no regulatory authority to place observers in this fishery. Late in 1990, emergency regulations were approved to make such observer coverage mandatory (subject to the availability of federal observers and other conditions) if fishing was to be conducted in a special "study zone" within 50 miles of the NWHI.

Of the six vessels which carried observers, four were east-coast swordfish longliners that had recently arrived in Hawaii, and two were Hawaii-based longliners--one having fished tuna in the main Hawaiian Islands (MHI) and the other having fished primarily tuna outside the MHI. Cooperation by the captains during the trips was excellent.

The six longliners, ranging in size from 63 to 88 ft, fished three areas: NWHI, MHI, and mid-Pacific waters (primarily north of Hawaii). Only one vessel fished in the each the MHI and NWHI, so no data on the fishing operations by area can be provided due to confidentiality procedures. Trip lengths varied from 11 to 23 days. The vessels used 20-50 mi of 3-4 mm monofilament main lines. Hooks primarily were baited with large, whole squid (300-400 g). The number of hooks deployed varied substantially (400-1800 per set), even within a trip. Light sticks of various colors were attached with rubber bands to branch or dropper lines. All vessels targeted swordfish initially, but during the last three observer trips, catches of market-sized swordfish were small, and the vessels shifted their attention to bigeye tuna, using the same gear and minimal changes in technique. Observers collected catch and effort data, biological measurements, and information on protected species interactions and fishing operations.

No interactions with protected species occurred in the MHI, but some occurred in the NWHI and mid-Pacific. No monk seals were sighted in any area. A solitary killer whale, *Orcinus orca*, was observed in the mid-Pacific waters on one set, and appeared to damage most of the fish catch; only heads and jaws of the fish remained on the hooks. No negative impact on the whale was apparent. The vessel moved to another location, with no further sightings. Porpoises were also seen in the vicinity of the gear during one NWHI set, but no physical interaction was seen.

In the NWHI, two large leatherback turtles, *Dermochelys coriacea*, were entangled in the fishing gear and released alive. In each case, the leader was cut as close to the hook as possible while the turtle remained in the water. (Both turtles were too large to bring on board, and handling the turtles was discouraged.)

In both the mid-Pacific and NWHI, there were incidents involving Black-footed albatrosses, *Diomadea nigripes*, and Laysan albatrosses, *D. immutabilis*. In each case, the birds were observed attacking the bait as the line was set. Two

birds were hooked and drowned. Thereafter, both vessels took precautionary measures to sink the bait more rapidly. This was evidently successful, as no more birds were found hooked.

The largest components (by number) comprising the catch consisted of blue sharks, *Prionace glauca*, which were generally cut loose, followed by swordfish, mahimahi, and bigeye tuna. The mean size of measured swordfish (N = 339) was 130.5 cm (eye orbit to fork of tail). The biological information acquired on these trips will be further analyzed by the Pelagic Resources Investigation of the Honolulu Laboratory.

B. Donald M. Schug, formerly of the Honolulu Laboratory and now a graduate student in the University of Hawaii's Department of Geography, recently completed "The Prospects for an International Fisheries Management Regime for South Pacific Albacore [*Thunnus alalunga*]" (SWFSC Administrative Report H-91-02).

Schug's report evaluates the current interest in establishing an international management regime for the South Pacific albacore fishery. Such interest increased, particularly by South Pacific island countries and US and New Zealand troll fishermen, as the result of the expansion of distant-water drift-net fishing in the mid- and late-1980s. His report also reviews various international arrangements for fisheries management in the South Pacific. Although a number of problems may frustrate the negotiation efforts by the Pacific island states and the distant-water fishing nations, current institutional arrangements encourage a solution to the albacore management problem.

Drawing from the political economy literature, Schug evaluates the prospects for an international management regime in light of a conceptual model of cooperative strategies in international negotiations. For international agreements subject to "uniformity rules" (i.e., any nation can reject the proposed agreement unilaterally), such models view each participant in negotiations as a self-interested maximizer of gains for her or his nation. There are six conditions that must be considered:

- Do the issues at stake lead to "contractarian interactions" (i.e., do both sides of the negotiation hold rights that can be exchanged, even though terms of exchange may be hard to determine in advance)?
- Do equitable arrangements for bargaining exist?
- Do salient solutions exist (i.e., can institutional arrangements actually be concluded once the idea of agreement is accepted)?
- Do compliance mechanisms exist?
- Are there exogenous shocks or crises which would increase the likelihood of success?
- Will effective leadership emerge to support such negotiations?

Schug does not predict the ultimate outcome of such negotiations, but he does conclude that the Law of the Sea's plea that nations cooperate on joint conservation and management of fishery resources will not come to fruition without work. Anticipation of the results of such negotiating work might be facilitated by continued examination of the six conditions identified in Schug's report.

C. Pooley, and Stacey S. Yoshimoto, Operations Research Analyst, recently completed a preliminary compilation of the Fishery Management Research Program's 1990 market monitoring data results for Hawaii pelagic fishery catch and effort.

Pooley and Yoshimoto consider monthly catch-per-trip data and their relationship with longline landings for 1987-90. This compilation was designed to identify trends in catch per trip by troll and handline vessels in Hawaii. The results were used by the Council in preparing amendments to the Pelagic FMP. Pooley and Yoshimoto found a strong correlation between their sample of Oahu-based trollers and handliners, and earlier work by Christofer H. Boggs, Fishery Biologist, who used the State of Hawaii's data on commercial landings by trollers.

Pooley also revised an earlier market analysis of Hawaii yellowfin tuna for the Council; this investigates the relationship between longline landings and the prices of yellowfin tuna. Pooley found no long-term trend in average monthly yellowfin tuna prices in 1987-90 for longliners or for trollers and handliners based in Oahu or the other MHI. A strong seasonal signal was identified based on the peak market season.

4. Richard W. Brill, Fishery Biologist in the Ecological Physiology Program, reported on the following two projects.

A. A manuscript entitled "Cardiovascular Responses of Skipjack Tuna (*Katsuwonus pelamis*) and Yellowfin Tuna (*Thunnus albacares*) to Acute Hypoxia," by Peter G. Bushnell (currently a postdoctoral fellow in the Department of Zoology, University of British Columbia) and Richard W. Brill, was completed and submitted to the Journal of Comparative Physiology.

This is the third in a series of papers resulting from a multi-year study of tuna reactions and tolerances to low ambient oxygen. The objective of the work is to allow prediction of movements, distributions and gear vulnerability of tunas as they relate to specific oceanographic conditions. Responses to acute reductions in ambient oxygen (hypoxia) were measured in small skipjack and yellowfin tunas. Fish that were prevented from swimming by a spinal injection of lidocaine were placed in front of a seawater delivery pipe and could, thus, set their own ventilation volumes. Heart rate, dorsal and ventral aortic blood

pressures, and cardiac output were continuously monitored. Water and blood samples were taken and oxygen levels determined in fluids afferent and efferent to the gills. From these data, various measures of the effectiveness of oxygen transfer, as well as branchial and systemic vascular resistance, were determined during normal water conditions and three levels of hypoxia.

Despite high ventilation volumes, tunas were able to extract approximately 50% of the oxygen from the inhalant water, partly because high cardiac outputs result in ventilation-perfusion conductance ratios close to the theoretically ideal value of 1.0. Tunas, therefore, have oxygen transfer factors that are 10-50 times greater than those of other fishes. The efficacy of oxygen transfer from water was found to be high in tunas and to match that measured in teleosts with ventilation volumes an order of magnitude lower.

These cardiorespiratory adjustments were apparently aimed at maintaining oxygen consumption. Most of the responses were similar to those previously reported in other fishes. However, hypoxic bradycardia was not accompanied by equivalent increases in stroke volume, and cardiac output fell as heart rate decreased. In both tuna species, oxygen consumption eventually was maintained by drawing on substantial venous oxygen reserves. This occurred at a higher pO_2 in skipjack tuna than in yellowfin tuna. The need to draw on venous oxygen reserves would make it difficult to meet the oxygen demand of increasing swimming speed, which is a common response to hypoxia in both species. Because yellowfin tuna can maintain oxygen consumption at a seawater pO_2 of 90 mm Hg without drawing on venous oxygen reserves, it was concluded that they could probably survive indefinitely at this level of hypoxia.

B. Another recent manuscript ("Anatomical and Biochemical Definitions of Burnt Tuna: Evidence of Calpain Proteolysis") was co-authored by Cheryl L. Watson (currently a postdoctoral fellow, Brown University), Henry A. Morrow (John A. Burns School of Medicine, University of Hawaii), and Richard W. Brill.

The white muscle of yellowfin tuna, bigeye tuna and southern bluefin tuna, *T. maccoyii*, is subject to a form of deterioration known commercially as "burnt tuna". Previous investigators have theorized that burnt tuna is either due to generalized proteolysis caused by lactic acidosis and high muscle temperatures, or to a more specific proteolysis caused by a calcium-activated neutral proteinase (calpain). The study by Watson, Morrow and Brill uses transmission electron microscopy and gel electrophoresis to quantify cellular differences between the white muscle of burnt and unburnt tuna and to determine whether the observed differences are consistent with generalized myofibrillar deterioration or the specific destruction of non-contractile myofibrillar proteins known to be caused by calpain.

These studies strongly suggest that burnt tuna is a calpain-mediated proteolysis that progresses fastest when the muscle is at physiologic Ph. The paper hypothesized that tuna with minimal white muscle glycogen reserves are likely to be more susceptible to the problem.

5. George W. Boehlert, Leader of the Fisheries Oceanography Research Program, reported on the following research on the distribution of tuna larvae near Oahu.

Boehlert and Bruce C. Mundy, Fishery Biologist, described the distribution of tuna larvae near Oahu in an SWFSC administrative report. This was the first study on scombrid larvae to use nets that sample discrete depth strata rapidly and simultaneously measure hydrographic variables. The report provides a detailed data record for further analysis of the patterns observed, and contains the first results from a larger study on the vertical distribution of all taxa of fish larvae near Oahu.

Fish larvae were collected with a 1 m^2 multiple opening-closing net and environmental sensing system (MOCNESS) and 0.49 m^2 neuston net in four cruises (September and December 1985 and April and June 1986). The MOCNESS contains eight opening-closing nets on a single frame, as well as CTD sensors which measure water temperature, salinity, net depth, and volume of water filtered as plankton are collected.

In each cruise, fish larvae were collected during day and night at stations 1, 5, and 15 nm off leeward Oahu and 2, 5, and 15 nm off windward Oahu. At the inshore stations of each transect, samples were taken in eight depth strata (0-80 m); at the two offshore stations of each transect, samples were taken in nine strata (0-200 m).

Different genera had distinct patterns of offshore distribution (Figure 2). *Thunnus* larvae were often most abundant at the nearshore station of the leeward transect; most of those large enough to be identified specifically were yellowfin tuna (*T. albacares*). Densities (number of larvae/1000 m^3 water sampled) of yellowfin tuna larvae at the nearshore leeward station were often an order of magnitude greater than elsewhere. In contrast, larvae of skipjack tuna (*Katsuwonus pelamis*) were usually most abundant at the two offshore stations of each transect. Larvae of *Auxis* spp. (keokeo or bullet and frigate mackerels) showed no consistent onshore-offshore pattern. Although nearshore concentrations of *Thunnus* larvae have been reported in earlier studies by others at Oahu and French Polynesia, the importance of nearshore areas as tuna nurseries is unknown. The abundance of *Thunnus* larvae in the limited nearshore area needs to be compared to that in the vast offshore area, and the survival of larvae in each area should be evaluated.

Generic differences in vertical distribution also were found, but all tuna larvae occurred in the upper water column. *Thunnus* larvae were restricted to 0-64 m (most abundant at 0-20 m), *Katsuwonus* larvae were taken at 0-84 m (most abundant at 0-60 m), and *Auxis* larvae were usually found at 0-60 m (often widely distributed at 0-40

m). There was no consistent evidence for diel vertical migration, except that *Thunnus* larvae were captured in the neuston (0-1 m) at night but not during the day. The strongest diel change was seen in *Auxis* larvae at the nearshore, windward station in April 1986, when larvae were most abundant at 0-10 m during the day and at 50-60 m at night. This change could be explained by the increased mixing of the water (rather than migration) before the night sampling, as suggested by the temperature structure of the water column during these collections. Temperature appears to play an important role in the seasonal and vertical distribution of tuna larvae off Oahu. *Thunnus* larvae were never found in temperatures below 24.2°C, while *Katsuwonus* and *Auxis* larvae were not found at temperatures below 21.8°C. Tuna larvae were only found at depths and seasons when the water was at this temperature or warmer.

6. Christofer H. Boggs, Fishery Biologist in the Pelagics FMP Research Program, summarized the following observations regarding recaptures of tagged blue marlin.

Anglers in Hawaii have tagged and released over 600 Pacific blue marlin since 1980, by far the greatest number of blue marlin tagged anywhere in the Pacific. Of these, only about a dozen have been recaptured. Tagging is coordinated by the Cooperative Marine Gamefish Tagging Program managed by James Squire of the La Jolla Laboratory. Tags are supplied to Hawaii's anglers through the Honolulu Laboratory and the Hawaii International Billfish Association. Fishermen are encouraged to tag and release billfish which, if recaptured, can provide data on fish movements.

Two recent long-range recaptures show long-distance movements from Hawaii to the South Pacific and from Mexico to Hawaii--journeys of over 2,500 miles. One was a 120 kg (265 lb) blue marlin that swam to Hawaii from Mexico and was caught by Dale Simmons off Waianae, Oahu, on 7 December 1991. This fish had been tagged and released 14 mo earlier by Jim Clarke off Baja California. The second was a 50 kg (110 lb) Pacific blue marlin tagged by Robert O'Laughlin and Mike Holtz off Keahole Point, Hawaii, on 5 August 1991. It traveled to the South Pacific near the Marquesas Islands where it was caught three months later by Kikuji Ito, a longline fisherman.

Earlier recaptures of two other Pacific blue marlin also indicate long-distance movement across the Equator and from east to west across the Pacific. One was released off Baja California in October 1989 and recaptured near the Marquesas Islands in February 1991. The other was tagged off Christmas Island, Kiribati, in October 1985 and recaptured off New South Wales, Australia, in March 1986.

In contrast to these four long-distance recoveries, five Pacific blue marlin have been tagged and recaptured in Hawaii. These fish were released during the June-August fishing season. Four were recaptured during the same season in the year of release, and the fifth was recaptured in January of the following year. The seasonality of these tag returns and the low troll catch rate of blue marlin in September-May suggest that many blue marlin leave Hawaii for part of the year and then return.

The few recaptures of Pacific blue marlin not mentioned above have occurred off Mexico in the eastern Pacific after being tagged and released off Mexico or southern California.

Troll fishermen are the backbone of the Cooperative Marine Gamefish Tagging Program, which tagged a total of 274 billfish in Hawaii in 1990. Longline and handline fishermen have also helped by reporting recaptured fish and, recently, some longline fishermen have begun tagging and releasing fish. Captain Bobby LaRue of the longline fishing vessel GAIL ANN tagged and released four swordfish in November 1991. Two bigeye tuna and one striped marlin, tagged and released from NMFS research longline gear, have been recaptured in Hawaii. Cooperative Marine Gamefish Program tags can be identified by the "LA JOLLA, CA" address printed on the tag. Fishermen who capture fish with these tags or who release fish that are later recaptured are rewarded with caps emblazoned with a leaping marlin. Several other kinds of tags, some of which offer a cash reward, may also be recovered around Hawaii. All tag recoveries can be reported to Boggs.

Plan Administration and Enforcement

Administrative Activities (NMFS Southwest Region)

No administrative actions relating to foreign fishing in the western Pacific EEZ were required because no foreign fishing permits were requested for any vessels with which the USA has a Governing International Fishing Agreement.

The Southwest Region prepared for approval by the Secretary of Commerce and published in the *Federal Register* the following actions:

- Three final regulatory actions for Pelagic FMP Amendments 2, 3 and 4.
- Eight emergency actions including interim rule extensions, modifications, and corrections.
- Three notices of availability for Pelagic FMP amendments.
- Two notices of collection-of-information effective dates.
- One notice of final rule corrections.
- One notice requesting comments on modification of an emergency rule.

Specifics of these actions:

8 February 1991 (56 FR 5159) - emergency rule extension: longline permits and reporting requirements.

12 April 1991 (56 FR 14866) - emergency rule: longline moratorium.

18 April 1991 (56 FR 15842) - emergency rule: Northwestern Hawaiian Islands protected species zone (50-nm area closure to longlining).

31 May 1991 (56 FR 24731) - final rule: Pelagic FMP Amendment 2 (longline permits and reporting requirements).

19 June 1991 (56 FR 28718) - emergency rule: main Hawaiian Islands longline area closure.

24 June 1991 (56 FR 28718) - emergency rule extension and modification: longline moratorium.

2 July 1991 (56 FR 30376) - notice of availability: Amendment 3 (NWHI protected species zone).

19 July 1991 (56 FR 33211) - emergency rule extension and modification: NWHI protected species zone.

25 July 1991 (56 FR 34049) - notice of availability: Amendment 4 (longline moratorium).

2 August 1991 (56 FR 37023) - corrections on final rule, effective date extension, and modifications of management measures: longline permits and reporting requirements and main Hawaiian Islands longline area closure.

6 August 1991 (56 FR 37300) - emergency rule modification: longline moratorium.

18 September 1991 (56 FR 47163) - notice of effective date of collection-of-information and final rule: Amendment 2 (longline permits and reporting requirements).

20 September 1991 (56 FR 47701) - emergency rule extension: main Hawaiian Islands longline area closure.

16 October 1991 (56 FR 51849) - final rule: Amendment 4 (longline moratorium).

18 October 1991 (56 FR 52214) - final rule: Amendment 3 (NWHI protected species zone).

29 October 1991 (56 FR 55651) - notice of availability: Amendment 5 (main Hawaiian Islands longline area closure).

29 October 1991 (56 FR 55652) - notice requesting comments: modifications to main Hawaiian Islands longline area closure (exemption criteria).

20 November 1991 (56 FR 58516) - notice of effective date of collection-of-information and final rule: Amendment 4 (longline moratorium).

In 1991, the Pacific Area Office (PAO), Southwest Region, issued 167 western Pacific longline fishing permits to domestic fishing vessels, of which 156 also received Hawaii longline limited entry (LE) permits. The owners of 14 vessels were determined to be ineligible for LE permits. The PAO also processed 11 applications for the allowed one-time transfer of LE permits to new vessel owners.

From 30 September to 31 December 1991, as required by final rules implementing Amendment 2, the PAO received 254 telephone notifications from longline vessel operators regarding their vessels' return to port (primarily in Hawaii).

Under a revision to an emergency interim rule (effective between 21 November and 16 December 1991) the PAO processed three exemptions to the main Hawaiian Islands longline area closure. The exemptions were granted to longline vessels owners who had a long historic participation in, and dependence on, the longline fishery in the nearshore waters.

During the year, the Protected Species Program of the PAO placed an observer aboard a longline vessel that fished around the Northwestern Hawaiian Islands. A summary of the trip will be included in a future report containing information pooled from at least two other observer trips to the area.

Enforcement Activities

Details of enforcement patrols are provided periodically to the Council by the USCG and the NMFS Office of Enforcement. These periodic reports are on file at the Council.

In 1991, USCG C-130 aircraft logged 451 hours on foreign fisheries patrols. This was a significant increase from the 149 hr logged in 1990 and 139 hr logged in 1989. The aerial patrols were conducted around the main Hawaiian Islands, Northwestern Hawaiian Islands, Guam, American Samoa, Northern Mariana Islands, Johnston Island, Wake Island, Kingman Reef and Palmyra Island, and Howland and Baker Islands. USCG cutters patrolled 2728 hours of directed fisheries surveillance. Of these 2728 hours, 1240 were by the Guam-based USCG Cutter ASSATEAGUE. Additional cutter patrols were conducted in the main and Northwestern Hawaiian Islands, American Samoa, Howland and Baker Islands, Palmyra Island, and Wake Island.

The USCG aerial patrols were often accompanied by NMFS agents. During 1991, these joint patrols documented five domestic longline vessels fishing within the longline prohibited areas around the main Hawaiian Islands: TIGER MARIA, BLUE SEA, SEA DIAMOND, CAPTAIN VAN, and EAST OCEAN. Each vessel received a $25,000 civil

penalty. In addition, the NMFS seized the catches aboard these vessels, with a total value exceeding $30,000. The F/V EAST OCEAN was subsequently seized for several violations of the Magnuson Act, and is presently in litigation.

The NMFS increased its boarding activity of the Honolulu-based longline fleet to ensure that the logbooks were being properly completed. Some 35 violations were documented as a result of this increased effort, and the quality of the logbook information appears to have improved.

Habitat Issues

There is no information to suggest that the habitat of pelagic management unit species was subjected to major alterations in 1991. The continuing introduction of low-level pollution from diverse sources, however, combined with occasional pulses of higher levels, is an ongoing problem. The impacts of this pollution on management unit species, particularly the egg and larval stages, is unknown. Pollution sources include runoff from high islands, sewage from island outfalls and ships, oil from ship bilges and accidental spills, and marine debris originating from land or ships in the region, or drifting in from other areas.

The Council and NMFS continue to receive and review periodic reports of the ocean dumping of cannery waste from the two tuna canneries in Pago Pago, American Samoa. The dumping is authorized under special permits from the US Environmental Protection Agency. No significant impacts have been noted.

Five-Year Review of Fishery Management Plan

The Fishery Management Plan (FMP) includes a provision that the FMP shall be reviewed after five years to determine if the plan is having the intended effects and if management changes are necessary. Five years have elapsed, and this section addresses the review requirement.

The FMP was implemented at a time (1987) when domestic fisheries were relatively stable, and when foreign fishing by longline gear was perceived to be the principal management concern in the area. Foreign longline fishing had previously taken large amounts of non-tuna species of concern to fishermen in the western Pacific region, and controls were instituted to minimize such take. Among the controls were area closures, non-retention zones for certain species, and general permit, reporting, and observer requirements. At the time, the management of other tuna fisheries was not considered in the FMP because the Magnuson Act did not provide authority for managing such fisheries when negligible amounts of non-tuna were being taken. The FMP did not contain any management measures applicable to domestic fisheries. The FMP did contain provisions for an annual report, and such reports have been

prepared each year. In addition, the FMP was recently amended (including its objectives) to contain a definition of "overfishing" for the stocks covered in the FMP.

There have been considerable changes both in the fisheries and in the statutory authority for pelagic fisheries management in the western Pacific under the Magnuson Act since the FMP went into effect. First, domestic longline fishing has increased dramatically in the waters around Hawaii, and beyond the EEZ surrounding Hawaii. This has given rise to many changes in the FMP management measures, which now include:

- longline permit and logbook reporting requirements to obtain more complete catch and effort data to better assess stock status and impacts on other fisheries,
- longline area closures around the Northwestern Hawaiian Islands to prevent the take of endangered Hawaiian monk seals,
- longline area closures around the main Hawaiian Islands and Guam to prevent gear conflicts with small-boat troll and handline fisheries, and
- a longline fishery limited-access program that will expire in April 1994.

The Council is developing a FMP amendment to replace the current limited access program, as well as considering limited access or permit/reporting requirements for other sectors of the pelagic fishery.

Second, the Magnuson Act has been amended to include tuna among the species for which the USA has exclusive management authority in its EEZ. Thus, the scope of the Council's interest now extends to the largest fisheries in the Pacific on an ocean-wide basis, and to foreign and domestic fisheries that take tuna in and beyond the EEZ. An amendment is under review that would incorporate tunas in the FMP, and all pelagic fisheries will be considered in a future amendment to replace the current limited-access program for longliners.

The annual reports and the many FMP amendments prepared in the past two years make it clear that the Council has continually been engaged in an evaluation of the FMP, both in terms of the extent to which the FMP is achieving its objectives, and the changes needed to address new problems and concerns. The FMP has been amended five times since its implementation, and there have been several emergency actions to address critical problems on an interim basis until amendments could be implemented. Further, the Council is developing a comprehensive pelagic fisheries management regime for implementation in 1994, when the limited-access system for longliners expires. This amendment will encompass tunas and other species and will, therefore, consider all foreign and domestic fisheries.

The Council concludes, therefore, that requirement for the five-year review under the FMP has been met. The FMP has been amended as the fishery changed and changes in management become necessary to address current and prospective problems.

Appendix 1

Territory of American Samoa

Introduction

The American Samoa pelagic fishery is monitored by the Department of Marine and Wildlife Resources (DMWR), through a program established in conjunction with the Western Pacific Fishery Information Network. Prior to 1985, only commercial landings were monitored. From October 1985 to the present, data were collected through a creel survey and, therefore, accounted for subsistence and recreational fishing in addition to commercial landings. The staff of the DMWR prepared this report using information that was derived from a statistically-designed survey of all pelagic fishing activities.

Fishing tournament data were supposed to be included in this report, but data processing delays have prevented inclusion of the tournament statistics. Those analyses should be ready for the 1992 report. Each year several fishing tournaments are held on Tutuila, the main island. Tournament catches are usually sampled completely, with individual weights recorded for all fish species (except skipjack tuna) recorded. Normal creel surveys are never scheduled on tournament days since they are not representative of a "typical" fishing day (e.g., more than the usual number of boats will fish in tournaments, and fishing techniques shift from those that target skipjack, to those that target billfish and mahimahi).

Summary

The pelagic fishery in American Samoa, which began in the early 1970s, continues to operate on a small scale. In 1991, 30 boats made an estimated 701 trips where a pelagic fish species was landed. The majority of the boats operated on a part-time basis, and most trips were one day in duration.

In general, American Samoa's pelagic fishery appears to be driven more by economics and the effects of hurricanes than by species abundance and availability. In the early 1980s, the fishery enjoyed rising prices and government assistance in the form of low interest loans for boat purchases and an active program to develop gear types and techniques applicable to American Samoa.

Several devastating hurricanes have struck the territory recently: Tusi in January 1987, Ofa in February 1990, and Val in December 1991. The effects of these hurricanes can be seen in the fishing effort data; notable decreases in effort are seen in 1987 and 1990. Corresponding drops in catch and revenue are also evident. Because Hurricane Val

occurred late in 1991, its effects will probably be seen more in the 1992 data than in 1991's.

Prices paid to fishermen for Pelagic Management Unit Species (PMUS) have fluctuated, but have not generally kept pace with inflation. The inflation-adjusted revenue per vessel-trip dropped to an all time low in 1990 and 1991.

The fishery faces competition from two main sources. First is continuing competition from a supply of frozen fish, either purchased or bartered from foreign longline vessels moored in Pago Pago Harbor. In some cases, vessel skippers act as middlemen in the transactions. Poor documentation of these transactions makes it difficult to assess the influence of these fish on the market for fresh fish that are supplied by local fishermen. The local fishery also competes with fresh fish that are flown in from Western Samoa and Tonga. Storekeepers in American Samoa report that the importers can often provide a more consistent supply and better prices than can be obtained from the local fishing fleet. These imports have been increasing in the past four years, but incomplete market surveys make it difficult to accurately quantify the magnitude of these imports.

Recommendations

- A sharp decline in the number of boats participating in the pelagics fishery in the past few years has been identified. *The dynamics and causes of this decline need to be thoroughly analyzed during the next year.* Analyses of entry and exit patterns will require tracking of individual vessels and fishermen through time to properly document the magnitude of the changes.

- The data collected during fishing tournaments has not been included in previous reports to the Council because the data had not been processed. Tournament data from 1974 to the present were entered into a database in 1991-92, making it accessible for analysis. *In preparation for the 1992 annual report, a description of tournament data collection methods and data limitations should be completed, and analyses of CPUE and fish size frequencies should be conducted.*

Table 1. American Samoa 1991 estimated total landings of pelagic species.

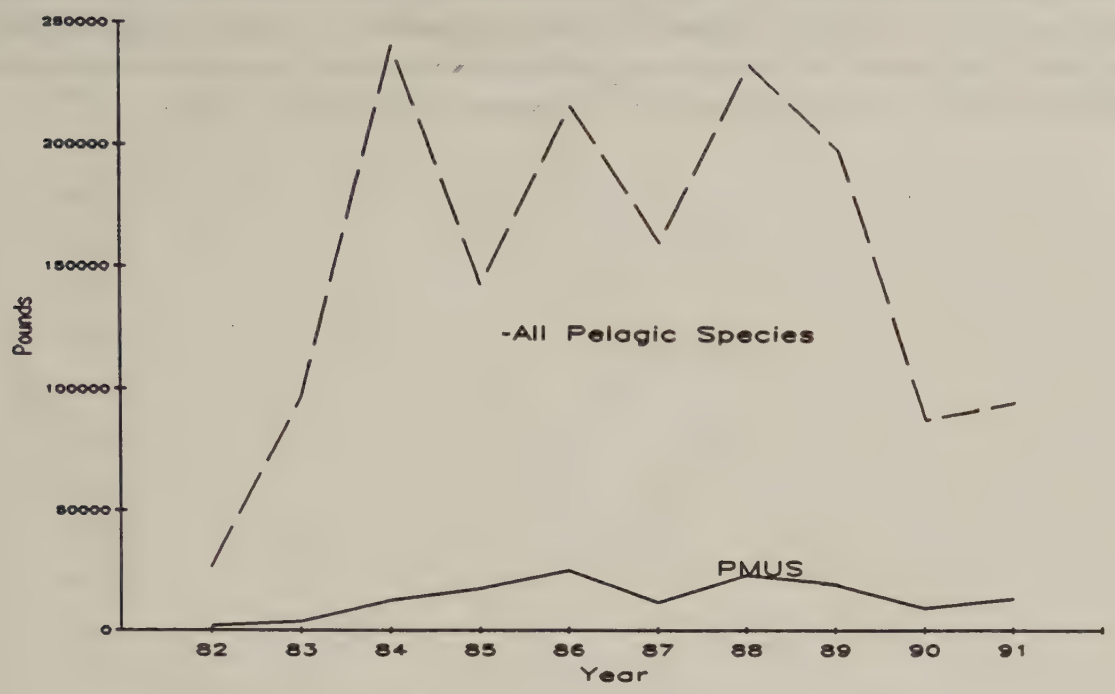
Species	Pounds
Sharks	3284
Mahimahi	1843
Blue marlin	7403
Wahoo	978
Subtotal PMUS[1]	**13508**
Skipjack tuna	43751
Dogtooth tuna	1448
Albacore	1653
Yellowfin tuna	32569
Kawakawa	109
Subtotal Tunas	**79530**
Rainbow runner	147
Barracudas	1684
Subtotal Misc.	**1831**
Total Pelagics	**94868**

[1] Prior to 1992, tunas and related species were not included as Pelagic Management Unit Species (PMUS). The 1992 annual report will reflect their inclusion in the management unit.

Table 2.
American Samoa 1991 estimated commercial landings, value and average price of pelagic species.

Species	Pounds	Value ($)	$/lb
Sharks	1326	1855	1.40
Mahimahi	1547	2263	1.46
Blue marlin	2912	4368	1.50
Wahoo	547	531	0.97
Subtotal PMUS	**6333**	**9017**	**1.42**
Skipjack tuna	32500	31667	0.97
Dogtooth tuna	997	1873	1.88
Albacore	1477	3692	2.50
Yellowfin tuna	30127	62399	2.07
Kawakawa	92	179	1.95
Subtotal Tunas	**65192**	**99810**	**1.53**
Rainbow runner	59	100	1.70
Barracudas	1253	2107	1.68
Subtotal Misc.	**1312**	**2207**	**1.69**
Total Pelagics	**72836**	**111034**	**1.52**

Figure 1. American Samoa annual estimated total landings: all pelagics and PMUS.



Year	Pounds Landed	
	All Pelagics	PMUS
1982	26396	1937
1983	96318	3750
1984	241099	12439
1985	142570	17554
1986	216299	25223
1987	159994	11684
1988	233830	23226
1989	198248	19366
1990	87823	9210
1991	94868	13508

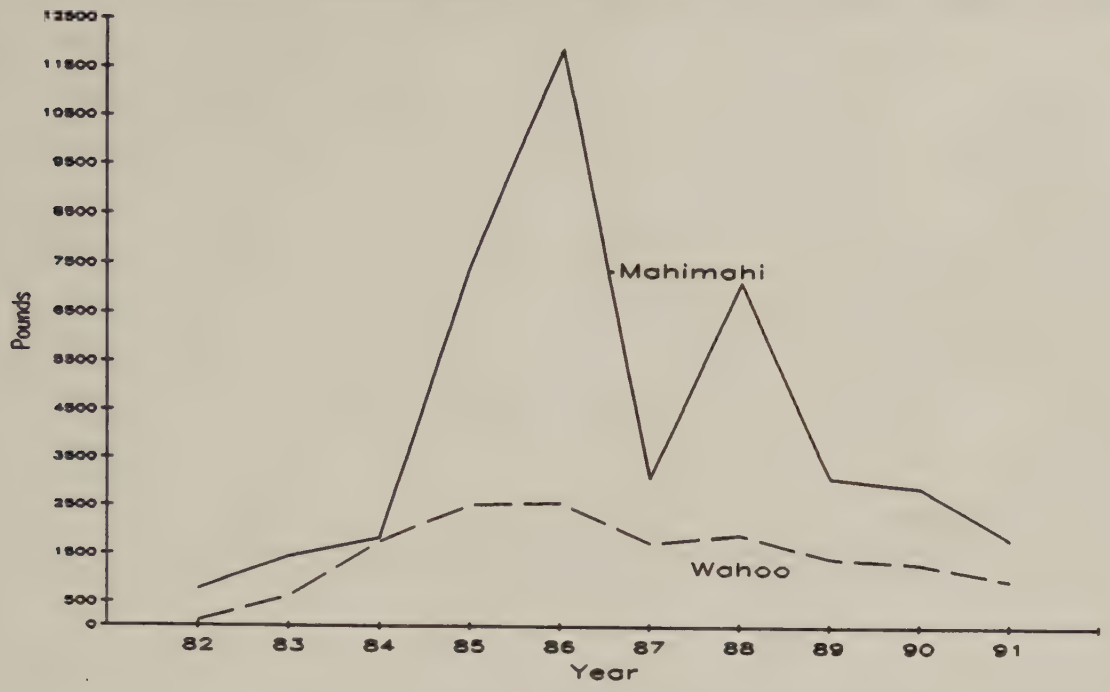
Calculation: Estimates for all pelagic species and PMUS by all fishing methods are summed. These values include both commercial and recreational/subsistence components of the fishery.

Interpretation: Although landings have been highly variable, 1990 and 1991 landing levels are notably low, due mainly to reduced fishing effort after Hurricane Ofa hit in February 1990. Tunas are the main component of the total pelagic landings, comprising

approximately 90% of the catch in any given year. The PMUS contribution to the total catch is suspected to be much higher for tournament days, which are not included here (see Introduction). Trolling is the gear type responsible for the vast majority of pelagic species catch in all years, but some large landings of primarily tuna species were made by a single domestic longline vessel which operated from 1983 to 1985.

Figure 2.

American Samoa annual estimated total landings: mahimahi and wahoo (average price per pound from the commercial catch is also shown in the table).



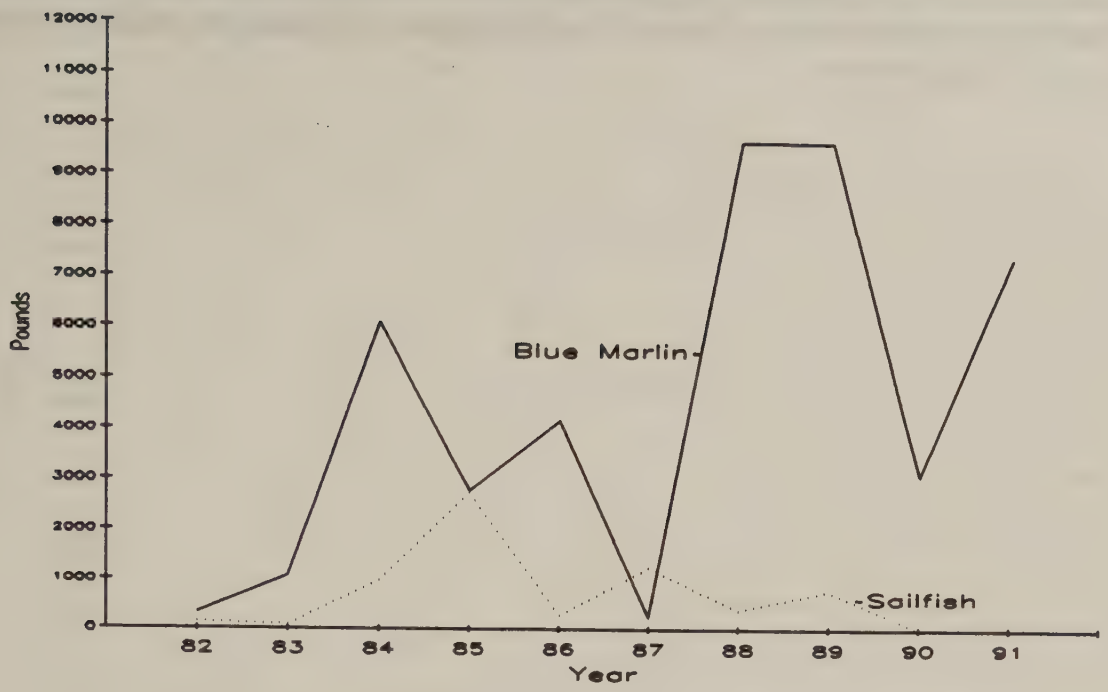
Year	Mahimahi		Wahoo	
	Pounds	$/lb	Pounds	$/lb
1982	778	1.00	114	1.10
1983	1443	2.08	632	1.46
1984	1844	1.23	1777	2.64
1985	7528	2.08	2535	1.23
1986	11929	1.52	2587	1.41
1987	3115	1.24	1753	1.42
1988	7184	2.02	1923	1.39
1989	3119	1.94	1443	1.00
1990	2922	1.04	1327	0.87
1991	1843	1.46	978	0.97

Calculation: The estimated total landings for mahimahi and wahoo are summed for all fishing methods. Prices in the table are not adjusted for inflation.

Interpretation: Wahoo landings continue to be relatively stable, and contribute only small amounts to the total catch. Mahimahi landings are highly variable through time; the reasons for this variability are unknown, but this variability is evidenced in each of

the region's island groups. Mahimahi landings and CPUE roughly mirror the prices paid to fishermen, indicating that this fishery is driven as much by economics as by species abundance or catchability. From 1984-88, American Samoa fishermen exported mahimahi to Hawaii, but this market has not operated recently.

Figure 3. American Samoa annual estimated total landings: blue marlin and sailfish.



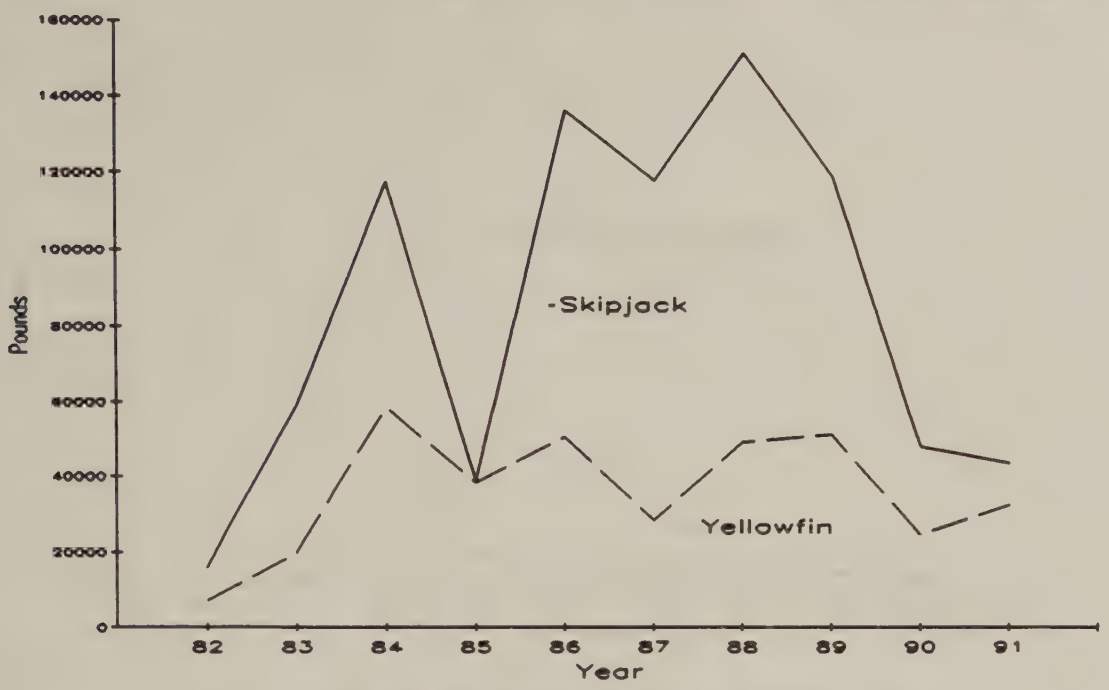
Year	Pounds Landed	
	Blue Marlin	Sailfish
1982	316	127
1983	1083	74
1984	6097	989
1985	2778	2744
1986	4182	263
1987	246	1257
1988	9697	390
1989	9693	785
1990	3084	0
1991	7403	0

Calculation: The estimated total landings of blue marlin and sailfish are summed for all fishing methods.

Interpretation: Landings of both species have been historically variable. Local commercial fishermen rarely target billfishes because of the lower CPUE and market price, relative to skipjack tuna. An exception would be on tournament days, where fishing strategy is vastly different. Tournament data are not included in these figures

(see Introduction). Prices for both of these species have been remain relatively low and stable, ranging from $0.72 to $1.01 per pound. The large fluctuations in catch and CPUE (see Fig. 10) for these species is probably related to species abundance or other unknown biological factors.

Figure 4.
American Samoa annual estimated total landings: skipjack and yellowfin tuna (average price per pound from the commercial catch is also shown in the table).



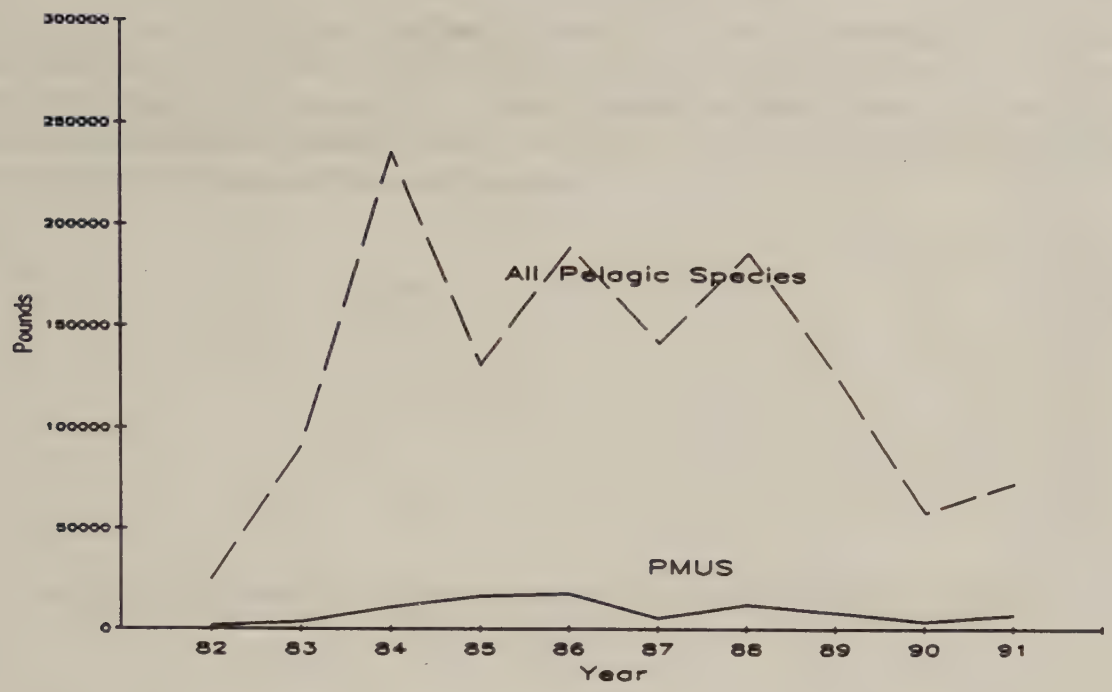
Year	Skipjack Tuna		Yellowfin Tuna	
	Pounds	$/lb	Pounds	$/lb
1982	15877	0.81	7038	0.98
1983	58997	0.60	19789	0.89
1984	117693	0.48	58704	0.73
1985	38939	0.87	38343	0.99
1986	136644	0.85	50730	0.86
1987	118169	0.71	28367	1.28
1988	152093	0.69	49447	1.28
1989	119419	0.77	51449	1.45
1990	48315	0.96	24567	1.50
1991	43751	0.97	32569	2.07

Calculation: The estimated total landings of skipjack and yellowfin tuna are summed for all fishing methods. Prices shown are not adjusted for inflation.

Interpretation: Skipjack and yellowfin tuna are the two main contributors to total pelagic landings (see Table 1). The decreased landings seen in 1990 and 1991 are a result of decreased effort in the case of yellowfin tuna, and the combined effects of a decreased effort and decreased CPUE in the case of skipjack tuna, (see Fig. 11). Although nominal

prices have been relatively stable for skipjack, real (inflation-adjusted) prices have dropped substantially over the past decade, which, when combined with the disruptive effects of Hurricanes Ofa and Val, probably explain the overall decrease in fishing effort seen in American Samoa.

Figure 5.
American Samoa annual estimated commercial landings: all pelagics and PMUS.

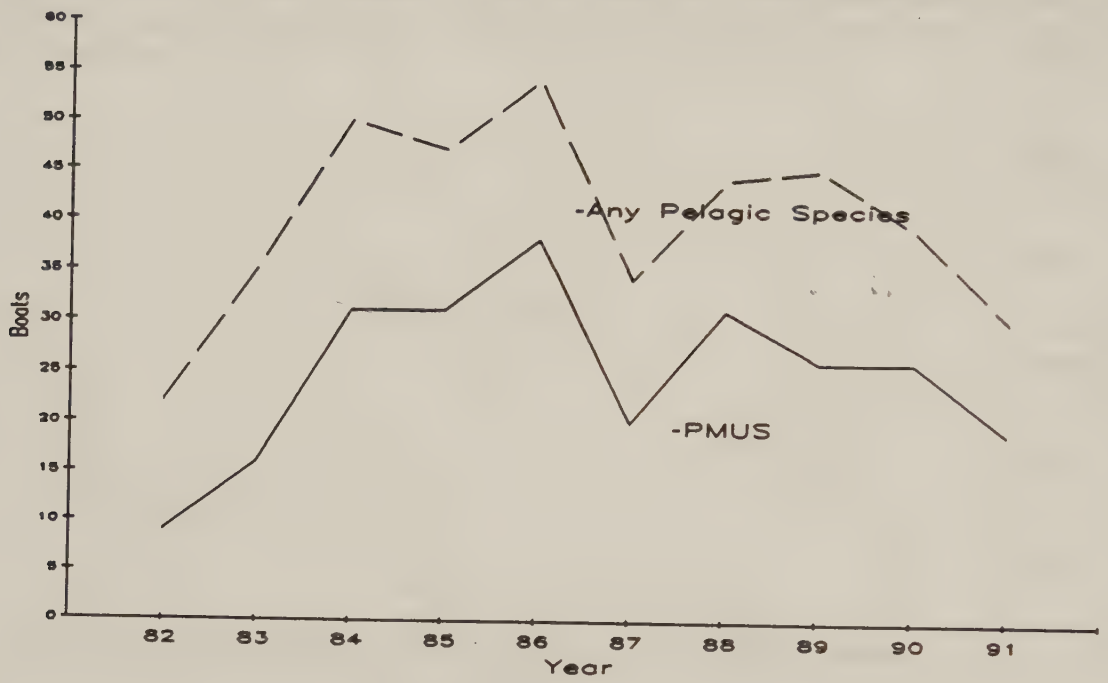


Year	Pounds Landed	
	All Pelagics	PMUS
1982	24820	1345
1983	90744	3524
1984	236216	10831
1985	131623	16474
1986	189403	17715
1987	142455	5250
1988	187059	12153
1989	126427	8196
1990	58535	3752
1991	72836	6333

Calculation: The total estimated pounds of all the pelagic species and PMUS are summed for all methods of fishing, only for fish that were sold.

Interpretation: The decrease in commercial pelagic landings in 1990 and 1991 is due mainly to decreases in tuna landings as discussed in Figure 4. Pelagic management unit species comprise only a small proportion of the total commercial landings of pelagic fish.

Figure 6. Number of American Samoa boats landing pelagic species and PMUS.



Year	Number of Boats Landing	
	Any Pelagics	PMUS
1982	22	9
1983	35	16
1984	50	31
1985	47	31
1986	54	38
1987	34	20
1988	44	31
1989	45	26
1990	39	26
1991	30	19

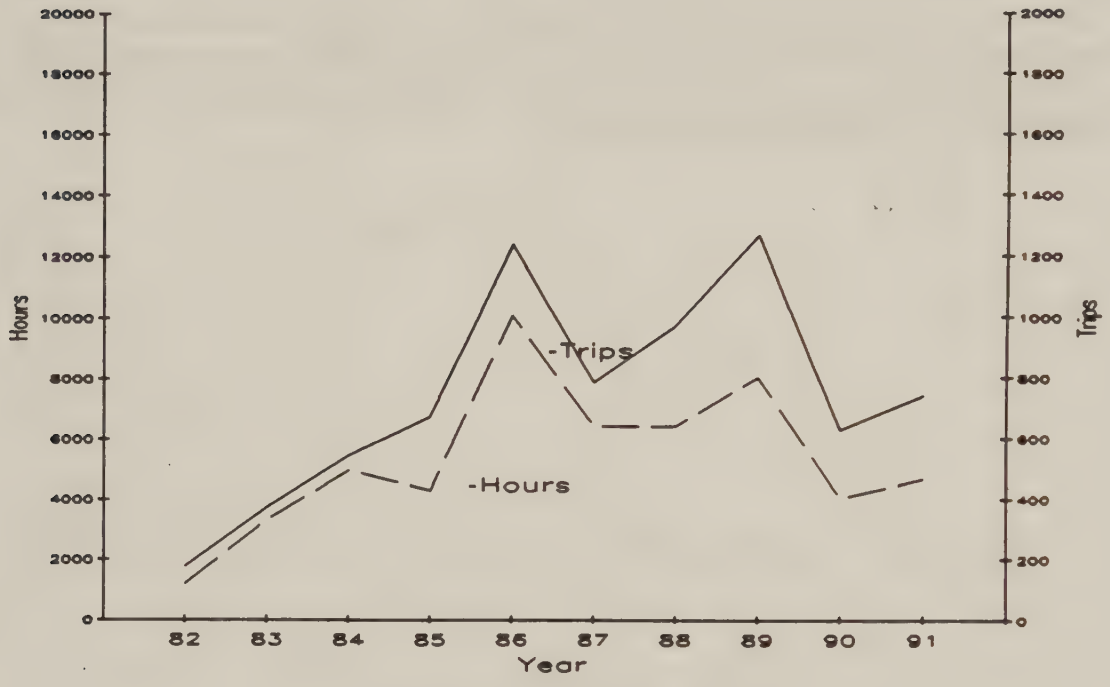
Calculation: The sampling program is extensive enough, and the number of boats is small enough, to use the raw database counts of the number of unique vessels in a given year. When the data are collected, the vessel is always identified. Each of the boats counted in the above table made at least one recorded landing of at least one pelagic species during a given year.

Interpretation: There is a difference in the number of boats which landed any pelagic species and the number of boats which landed at least one PMUS during any given

year. This difference was not investigated, but it seems logical that it is a result of many boats targeting skipjack tuna.

A drop in the number of boats fishing in the area has been observed in the last several years. Although this can be attributed partially to damage caused by hurricanes, preliminary analysis uncovered a somewhat complex participation scenario that will require more detailed analyses to fully understand the entry/exit patterns in this fishery. These analyses will be undertaken next year.

Figure 7.
American Samoa annual estimated effective fishing effort for pelagic species (trolling method only).

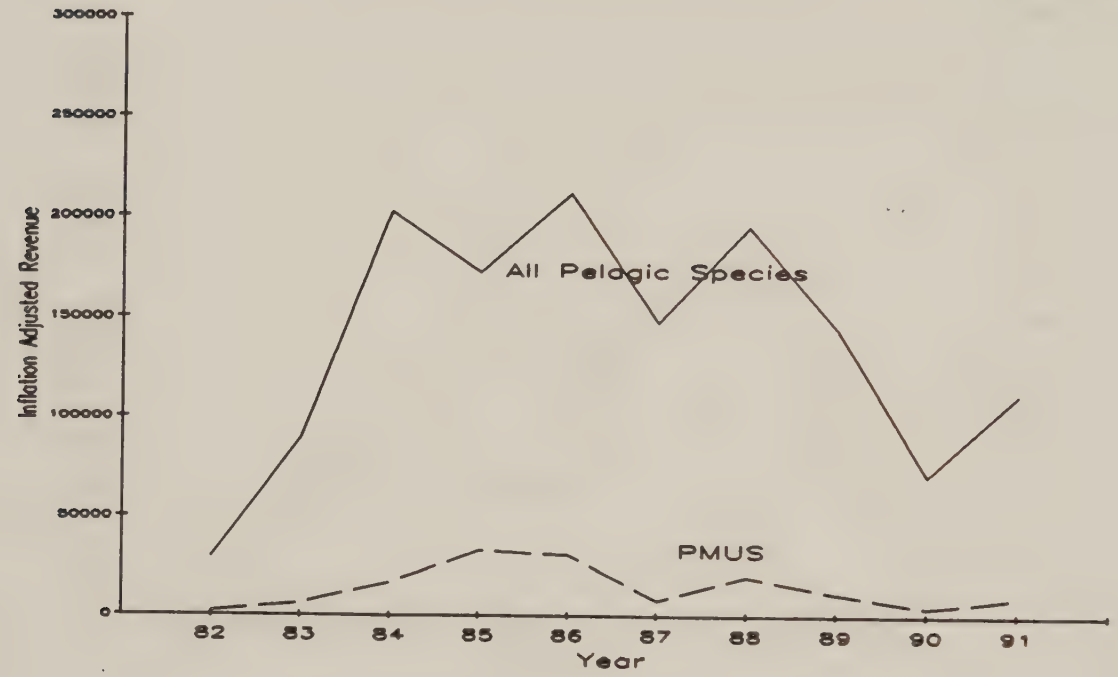


Year	Hours	Trips
1982	1198	177
1983	3326	374
1984	4969	548
1985	4292	675
1986	10065	1238
1987	6405	787
1988	6425	975
1989	8049	1269
1990	4051	629
1991	4652	741

Calculation: The estimated total annual landings of all pelagic species is used as a base for calculating the estimated number of trips and hours spent fishing for pelagic species by vessels using trolling methods only. The estimated total longliner landings are subtracted from the total pelagic landings, and the resultant number is divided by the average catch per hour (CPUE) for the trolling method to give an estimate of the hours trolled. The CPUE is calculated using only those trips which only trolled, and for which the number of hours was recorded. The number of trips is calculated by dividing the estimated annual number of hours by the average length of a trolling trip.

Interpretation: The amount of effort expended to catch pelagic species has been variable, owing largely to the number of boats in the fleet making pelagic landings, (see Fig. 6). The fleet has expanded since 1982, but has suffered setbacks in 1987, 1990 and 1991 due to hurricanes.

Figure 8.
American Samoa annual estimated inflation-adjusted revenues for commercial landings of all pelagics and PMUS.

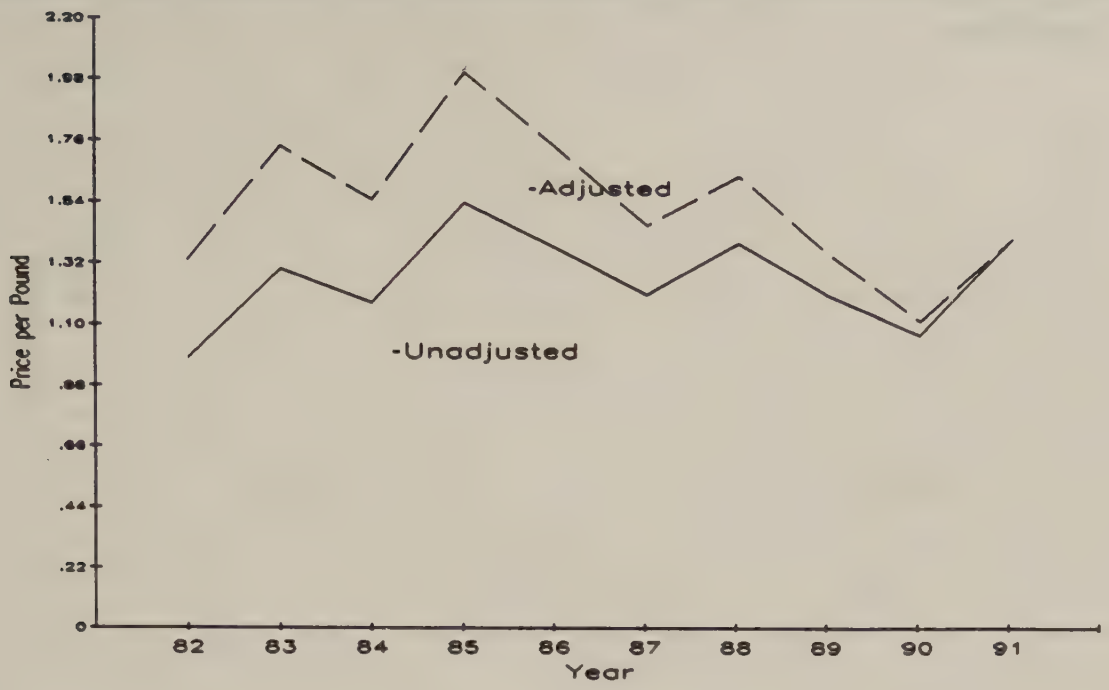


Year	Revenue ($)	
	All Pelagics	PMUS
1982	29528	1791
1983	88913	6148
1984	202253	16883
1985	172136	33004
1986	211212	30979
1987	147233	7684
1988	194659	19899
1989	143652	11124
1990	70170	4185
1991	111034	9017

Calculation: Revenues from commercial landings for all pelagic species and PMUS (see Fig. 5) are adjusted for inflation by multiplying a given year's revenue by the quotient of the 1991 consumer price index (CPI) divided by the CPI for that year.

Interpretation: The sharp decline in 1990 revenues is the combined result of reduced prices and landings. Pelagic revenues recovered slightly in 1991, but were still substantially below the levels generated by the fishery in the 1980s.

Figure 9. American Samoa average price of pelagic management unit species.



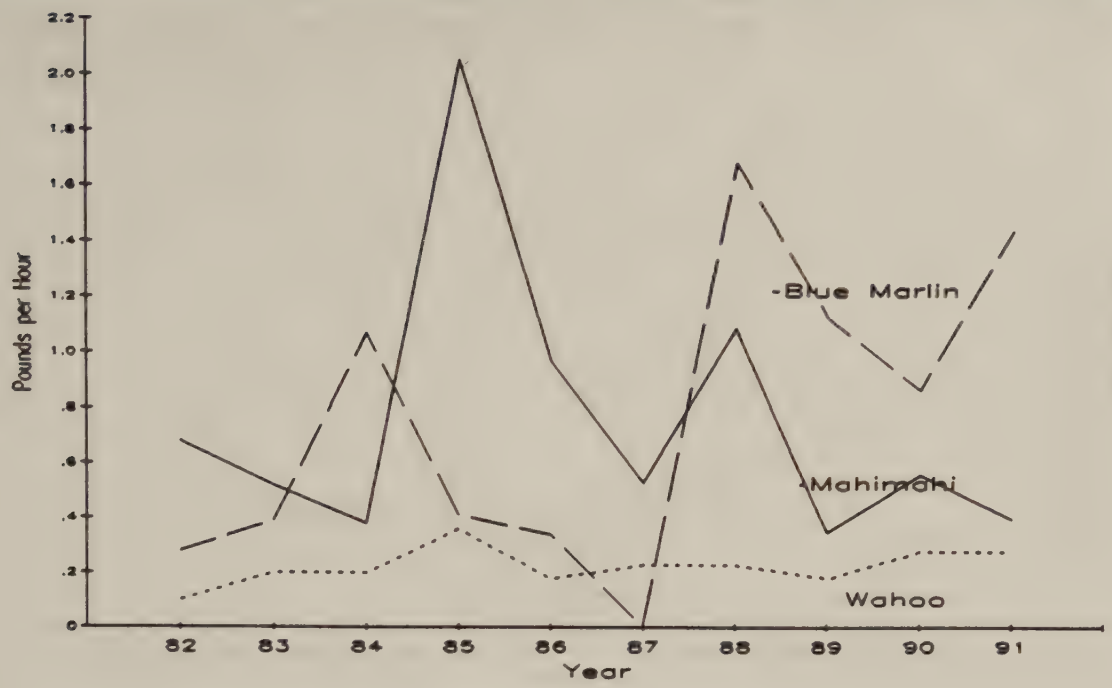
Year	PMUS Price ($/lb)	
	Unadjusted	Adjusted
1982	0.98	1.33
1983	1.30	1.74
1984	1.18	1.55
1985	1.54	2.01
1986	1.38	1.74
1987	1.21	1.46
1988	1.40	1.64
1989	1.21	1.36
1990	1.07	1.12
1991	1.42	1.42

Calculation: The average PMUS price per pound for each year is calculated by dividing the estimated revenue by the estimated weight sold. The adjustment for inflation is made by multiplying the annual average price for a given year by the 1991 consumer price index (CPI) for American Samoa, and dividing by the CPI for the given year.

Interpretation: The downward trend in PMUS price per pound in recent years recovered somewhat in 1991. The 1990 adjusted price had fallen below that of 1982 (the historical low), but the 1991 recovery brought the price above that low mark. The relatively low

price may be the result of impact on the fresh fish market from the purchase/barter of frozen pelagic species from longliners. Prices remain below the average for the earlier years of the fishery.

Figure 10. American Samoa trolling catch rates: blue marlin, mahimahi and wahoo.

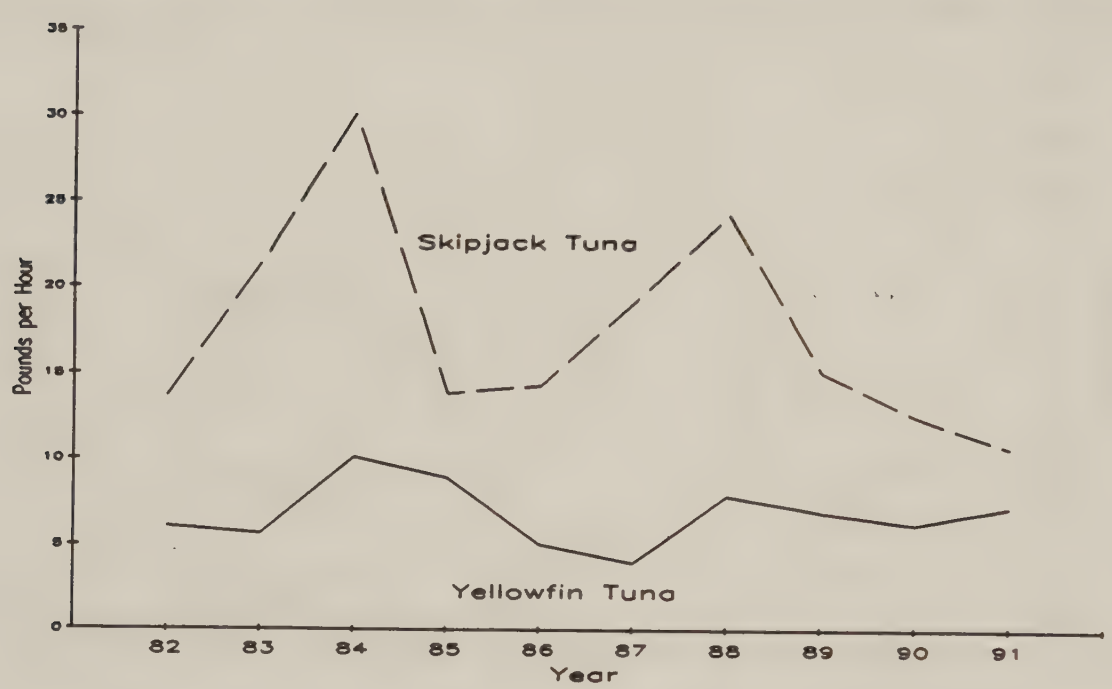


Year	Pounds Caught per Hour Trolling		
	Blue Marlin	Mahimahi	Wahoo
1982	0.28	0.68	0.10
1983	0.39	0.52	0.20
1984	1.07	0.38	0.20
1985	0.41	2.06	0.36
1986	0.34	0.97	0.18
1987	0.00	0.53	0.23
1988	1.69	1.09	0.23
1989	1.13	0.35	0.18
1990	0.87	0.56	0.28
1991	1.45	0.40	0.29

Calculation: For trips that used the trolling method exclusively, and where effort was recorded in hours, the sum of the individual species catch was divided by the sum of trolling hours to obtain CPUE.

Interpretation: CPUE for these species is highly variable. Wahoo CPUE peaked in 1990 and 1991, and the blue marlin CPUE is near an all-time high. It is difficult to say from these data whether the relatively low CPUE for mahimahi in recent years is related to fish abundance, or the relatively low prices for mahimahi in recent years. Fishermen targeted mahimahi for an export market to Hawaii in 1984-1986.

Figure 11. American Samoa trolling catch rates: skipjack and yellowfin tuna.



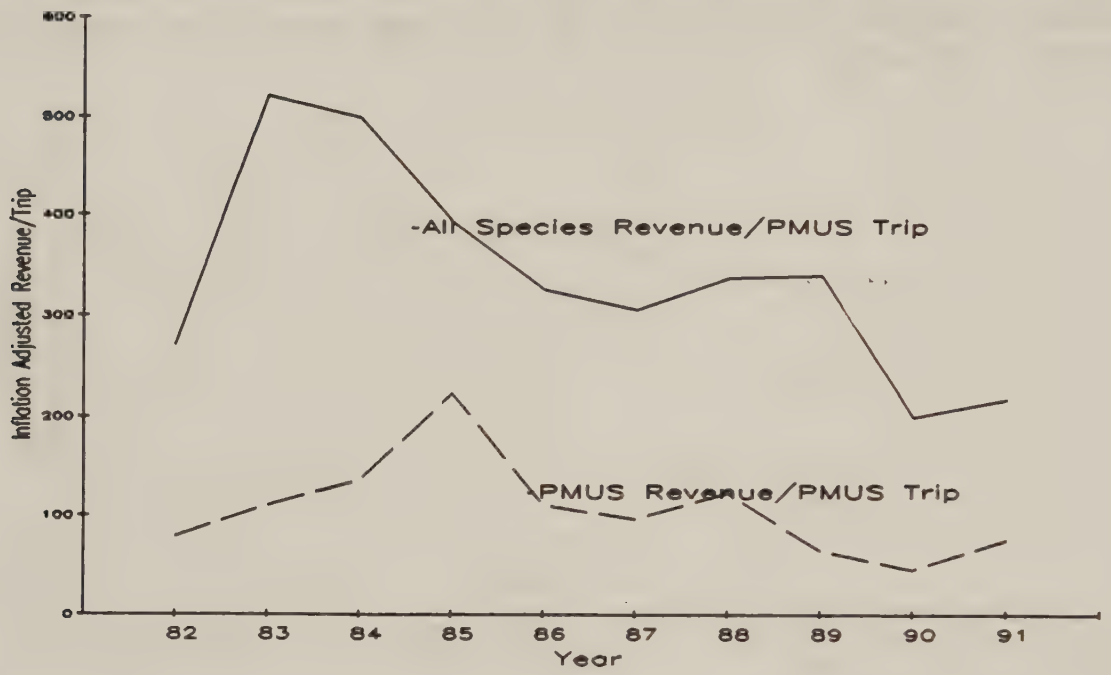
Year	Pounds Caught per Hour Trolling	
	Skipjack Tuna	Yellowfin Tuna
1982	13.6	6.1
1983	21.3	5.6
1984	30.0	10.1
1985	13.8	8.9
1986	14.3	5.1
1987	19.1	4.0
1988	24.2	7.8
1989	15.1	6.9
1990	12.4	6.2
1991	10.6	7.2

Calculation: For trips that employed the trolling method exclusively and where effort was recorded in hours, the sum of the individual species catch was divided by the sum of trolling hours to obtain CPUE.

Interpretation: Tuna CPUE has been highly variable through the years. Catch rates for skipjack in 1991 fell to a near record low, although catch rates for troll-caught yellowfin have risen to near record high levels. A possible explanation for this is that all but one of the FADs were lost shortly following Hurricane Ofa in February 1990, and prices paid

for yellowfin are roughly 60% higher than for skipjack. These combined factors may prompt fishermen to target yellowfin by fishing the offshore banks and using larger gear. An alternate explanation would be that these catch rates are solely a function of fish abundance or catchability.

Figure 12. American Samoa average inflation-adjusted revenue per trip landing PMUS.

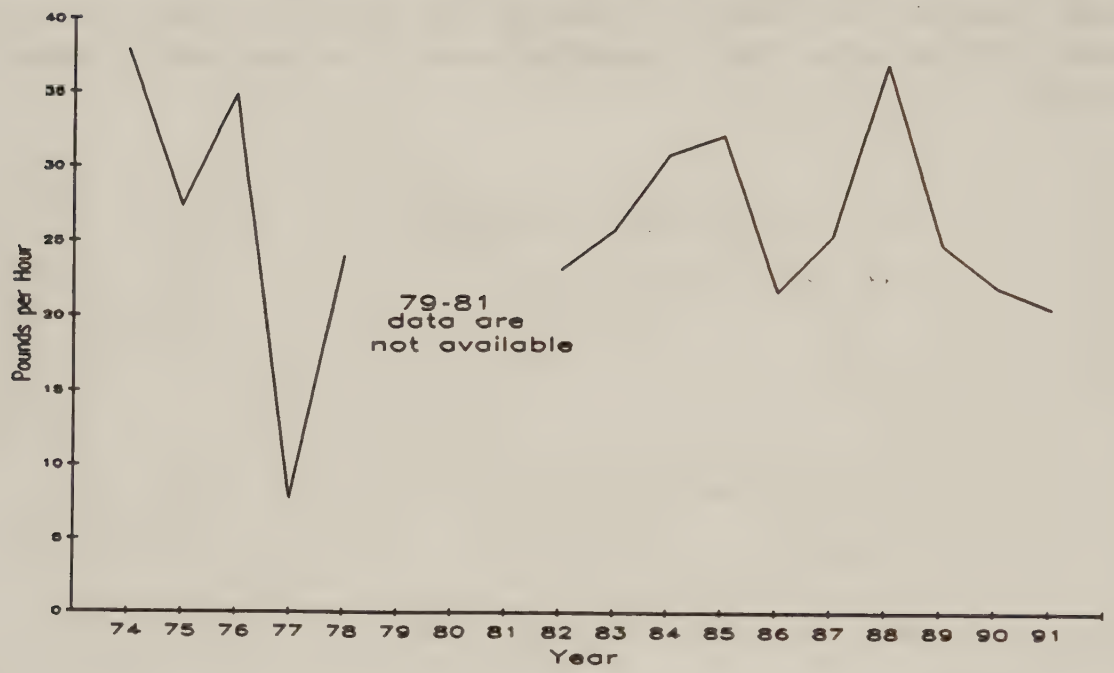


Year	All Pelagic Species Revenue per PMUS Trip ($)		PMUS Revenue per PMUS Trip ($)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	200	270	59	79
1983	388	520	82	111
1984	379	499	103	136
1985	300	392	170	222
1986	257	324	87	111
1987	251	304	80	96
1988	286	356	104	122
1989	301	339	57	65
1990	190	199	44	45
1991	215	215	75	75

Calculation: For each trip that landed any PMUS (excluding longline trips), and which sold at least a portion of their catch, the average PMUS revenue per trip and average total pelagic species revenue per trip was calculated. The revenues were adjusted for inflation by multiplying them by the quotient of the 1990 CPI divided by the respective year's CPI.

Interpretation: Revenues per trip plunged to nine-year low in 1990 and recovered only slightly in 1991, for both PMUS and the "all species" categories. This reflects the record low prices offered for PMUS and tunas (see Fig. 9). This trend is seen even more dramatically in the American Samoa bottomfish fishery, which has nearly collapsed in recent years.

Figure 13. American Samoa total pelagic catch per hour trolling.



Year	Pounds Caught per Hour	Trips	Source
1974	37.9	31	Dory Project
1975	27.3	98	
1976	34.8	10	
1977	7.8	6	
1978	23.9	96	
1982	23.0	119	Commercial Catch Monitoring
1983	25.7	168	
1984	30.7	316	
1985	32.0	290	
1986	21.5	401	Creel Census
1987	25.3	217	
1988	36.8	283	
1989	24.6	375	
1990	21.8	293	
1991	20.4	213	

Calculation: For trips using only trolling gear and where number of hours fished were recorded, the CPUE (pounds per hour) was summed and divided by the number of trips

to get a mean CPUE. Data are from three sources; 1974-78 are from the Dory Project, 1982-84 are from the commercial catch monitoring system, and 1985-91 are from the creel survey program.

Interpretation: Pelagic species CPUE is highly variable, especially in the early years of the American Samoa troll fishery. The extremely low CPUE in 1977 is possibly an artifact of the low number of observations or other data problem. A factor which probably affected the 1990 and 1991 CPUE was that all but one of the FADs surrounding Tutuila were lost shortly after Hurricane Ofa in February 1990. Declining catch rates may reflect declining abundance or availability of fish, but because fishing pressure is relatively low in American Samoa, it is improbable that fishing by the local fleet would be responsible in any large part for a decline in fish abundance or catch rates.

Appendix 2

Territory of Guam

Introduction

The staff of the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR) prepared this report, which contains standard fishery performance data for the Guam fishery. The information was derived from a statistically-designed survey of all pelagic fishing activities.

Summary

Guam's pelagic fishery is growing, particularly the charterboat segment.

Overall landings of pelagic species have varied widely from year to year, with a slight increase during the past five years. Landings of PMUS appear to be increasing while those of tunas appear to be decreasing. In the early 1980s, the bulk of the catch consisted of tunas, but since 1985 it has consisted of PMUS. Commercial landings of all pelagics and PMUS have increased during the past 12 years, while those of non-PMUS (almost exclusively tunas) have remained about the same.

There are wide inter-annual fluctuations in the catches of mahimahi, wahoo, and tunas. Annual landings of yellowfin tuna, however, appear to have declined since 1982. Annual landings of blue marlin have increased sharply during the same period.

Fishing effort in terms of hours and trips has increased since 1983, while the hours spent fishing per trip has decreased. This is a reflection of the growing charter segment of the fishery, which generally makes half-day rather than full-day trips.

Inflation-adjusted revenues for all pelagic species and PMUS have remained fairly steady during the past six years, while inflation-adjusted revenue per trip for all pelagic species and PMUS has decreased over the past nine years. With the exception of 1985, the average prices of PMUS have decreased steadily since 1980.

Annual trolling catch rates have varied widely for all species. However, there has been a general increase in the catch rates of blue marlin, and a decrease (since 1982) in the catch rates of yellowfin tuna. For yellowfin tuna caught in the Guam International Fishing Derby, the average size and size of the winning fish decreased from 1979 to 1989, but increased slightly during the past two years. The increased catch rate of blue marlin may be due to an increase in the charterboat segment

which operates larger vessels more capable of targeting this species. Decreases in the catch rates and size of yellowfin tuna may be a result of either adverse impacts on their regional stocks or interception near Guam by the longline or purse seine fisheries, or possibly natural variability or environmental factors.

The flooding of local markets with inexpensive foreign-caught fish severely depresses prices to local fishermen. These foreign-caught fish consist of lower-grades, primarily yellowfin and bigeye tunas that are destined for surface transhipment.

Two US longliners were licensed to fish within Guam's EEZ in 1991, but neither fished there, nor did they land fish caught elsewhere. One vessel has since left Guam, and the intent of the other is unknown.

Recommendations

- The Guam Department of Commerce is currently collecting data on foreign longline transshipments through Guam. *Relevant data should be formatted into an ASCII file and made available on 3.5 inch diskettes so that it can be accessed by DAWR Macintosh computers and other interested users.*

- *A program to collect foreign longline vessel data logbooks in Guam should be initiated. All foreign longline vessels fishing, transhipping, or home ported on Guam should be required to submit a daily catch logbook, as well as landings and transshipment reports to the Government of Guam and the NMFS.* A plan should be formulated to establish which Guam or NMFS agencies will be responsible for the collection and processing of this data, as well as enforcement. Although most foreign longline vessels may not be licensed to fish within the Guam EEZ, their fishing activities in adjacent EEZs impact the stocks of pelagic species migrating through the Guam EEZ. Since there is no mechanism to compel the governments of the Federated States of Micronesia, Republic of Belau, or the Republic of the Marshall Islands to collect this data or to provide it to the Plan Team (PT), it is necessary for the PT to obtain it by direct means. This should be a federal and Guam requirement, and enforcement should be a federal and Guam responsibility.

  All costs of this program and its enforcement should be born by the foreign fishing fleet. To this end, *a fee and permit system to allow the longline fleet to access Guam port facilities should be implemented. All fees collected should be dedicated to this program.*

- With the inclusion of tunas and related species under the Magnuson Act, it is imperative that catch, effort, and biological data from the domestic and foreign purse seine fisheries be made available to the PT. *Regulations should be established that require a federal purse seine fishing permit, a landings report, a transshipment report, and a daily catch logbook report for all domestic purse seine vessels fishing, transhipping, or home-ported anywhere in the Western*

Pacific Region. These reports should cover all PMUS whether incidental or targeted. *The same regulations should be established for any foreign purse-seine vessel fishing, transhipping, or home ported in any territory or EEZ governed by the Council*. Logbook data are necessary for effective management of this fishery as well as for defining overfishing as required by the revised National Standards. Significant enforcement effort is critical to ensure compliance with permit and reporting requirements by all vessels. Compliance and general support among the fishermen would be enhanced if reporting procedures are designed to fulfill both state/territory and federal requirements.

- *Support should continue to be supplied to and/or by the island fisheries offices for collecting data on their pelagic fisheries, including the volume of landings, revenue of sales, fishing effort, and size composition of the catch.*

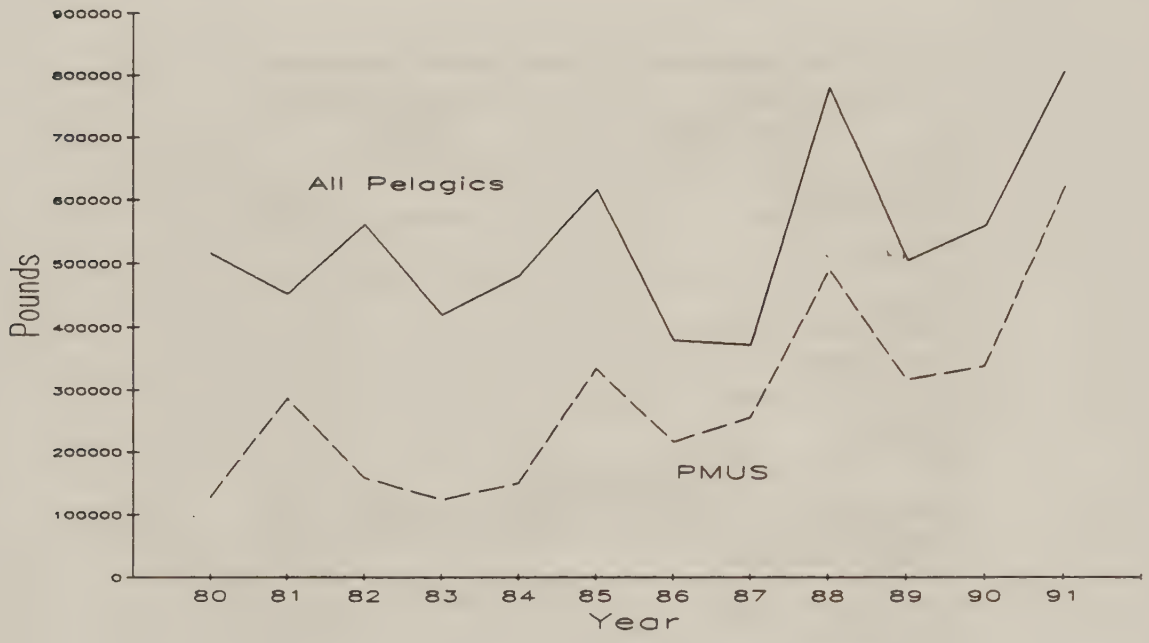
Table 1. Guam 1991 creel survey - pelagic species composition

Species	Pounds Landed
Sharks	8,115
Mahimahi	401,771
Wahoo	70,073
Blue Marlin	129,992
Striped Marlin	0
Sailfish	2,000
Subtotal PMUS	**617,768**
Skipjack Tuna	133,064
Yellowfin Tuna	46,443
Dogtooth Tuna	2,977
Kawakawa	2,697
Misc. Tunas	32
Subtotal Tunas	**184,313**
Rainbow Runner	2,453
Barracuda	2,134
Subtotal Misc.	**4,587**
Total Pelagics	**802,081**

Table 2. Guam 1991 annual commercial average price of pelagic fish.

Species	Average Price ($/lb)
Mahimahi	1.48
Wahoo	2.33
Marlin	0.90
Spearfish	1.61
Sailfish	1.36
Average PMUS	**1.54**
Skipjack Tuna	1.19
Yellowfin Tuna	2.38
Dogtooth Tuna	2.14
Kawakawa	1.35
Average Tunas	**1.62**
Troll-caught fish	2.39
Rainbow Runner	2.22
Barracuda	2.05
Average All Pelagics	**1.62**

Figure 1. Guam annual estimated total landings: all pelagics and PMUS.



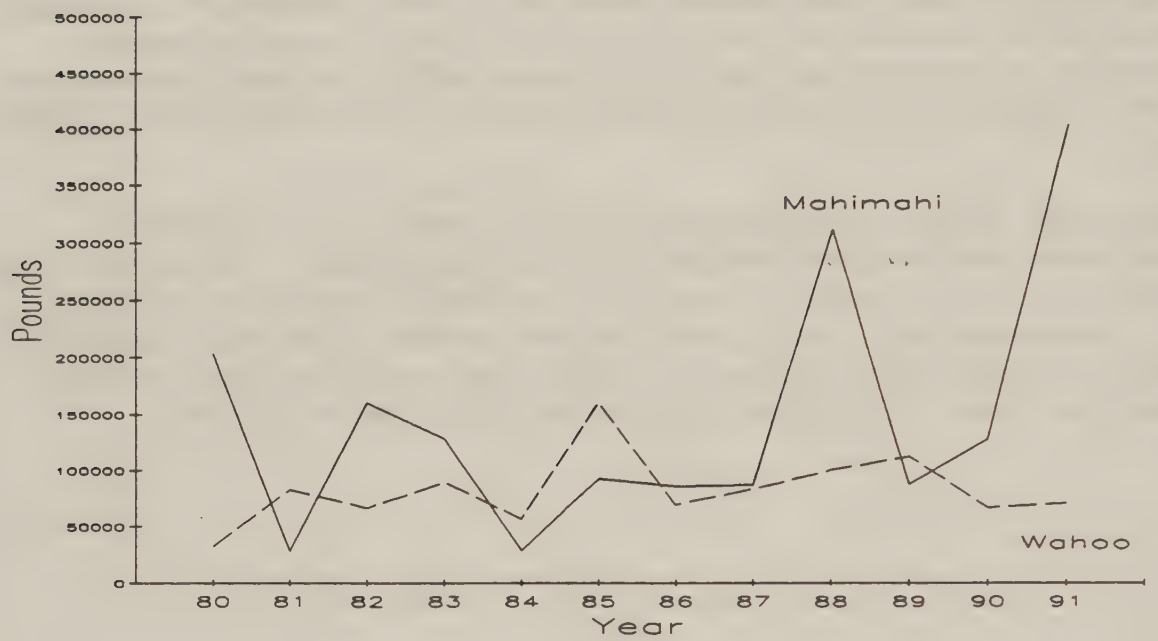
Year	Pounds Landed	
	All Pelagics	PMUS
1980	515,631	127,358
1981	450,814	285,993
1982	560,048	158,614
1983	418,222	123,189
1984	479,136	149,785
1985	614,522	332,274
1986	377,668	214,867
1987	370,586	254,725
1988	776,337	487,772
1989	501,880	314,432
1990	556,899	336,225
1991	802,081	617,768

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. The Guam Offshore Expansion System (GOES) and its algorithms are detailed in NMFS Administrative Report H-83-21C. A 362-day (363 days during leap

years) expansion is run for each calendar year of survey data, and is added to the results of the 3-day Guam International Fishing Derby (GIFD) to produce catch and effort estimates for each fishing method surveyed. Species composition is calculated by weight for the sampled catch for each method to produce catch estimates for each species for the expanded period. The annual catch for all pelagic species and the PMUS separately are summed across all methods to obtain the numbers plotted above.

Interpretation: Guam's pelagic fishery is growing, particularly the charterboat segment which has more than doubled during the past few years. In the early 1980s, the bulk of the catch consisted of tunas, but since 1985 it has consisted of other PMUS. Reasons for this include a trend towards decreasing size and availability of yellowfin tuna, lack of market interest in skipjack tuna, and an increasing interest in targeting blue marlin. Virtually all of the harvest (97%) is made by trolling.

Figure 2. Guam annual estimated total landings: mahimahi and wahoo.

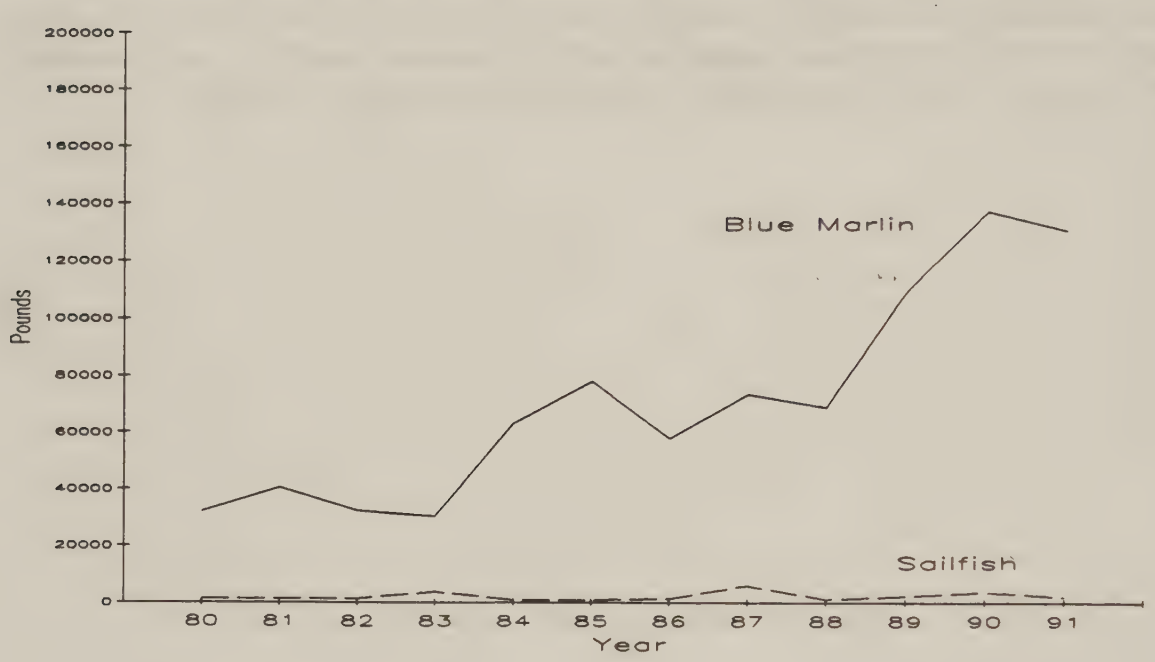


Year	Pounds Landed	
	Mahimahi	Wahoo
1980	203,136	32,825
1981	27,954	82,635
1982	160,200	66,416
1983	128,130	89,010
1984	28,847	56,501
1985	92,407	159,300
1986	85,393	68,830
1987	86,362	82,892
1988	310,032	99,801
1989	87,158	111,977
1990	127,087	66,285
1991	401,711	70,073

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. Totals by species are summed across all fishing methods as described in Figure 1.

Interpretation: Landings of mahimahi exceeded those of all other species during 7 of the past 12 years, making it the most important species in Guam's small boat fishery. Record high landings of mahimahi were recorded in 1991. Wahoo landings dropped in 1990 after three consecutive years of increasing landings, and were only slightly higher in 1991. Virtually all of the harvest was made by trolling.

Figure 3. Guam annual estimated total landings: billfishes.

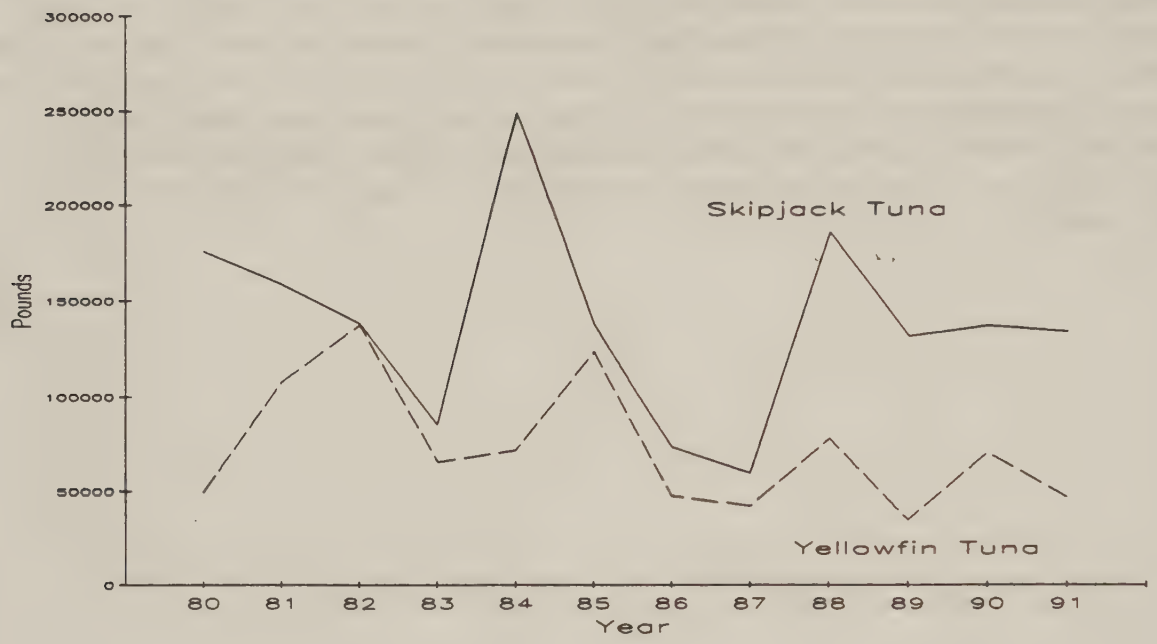


Year	Pounds Landed	
	Blue Marlin	Sailfish
1980	32,192	1,411
1981	40,389	1,272
1982	32,465	1,425
1983	30,359	3,820
1984	63,057	952
1985	77,565	915
1986	57,682	1,474
1987	73,169	5,913
1988	68,511	1,145
1989	109,241	2,191
1990	136,541	3,730
1991	129,992	2,000

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. Totals by species are summed across all fishing methods as described in Figure 1.

Interpretation: Landings of blue marlin have steadily increased during the past 12 years, with this growth being particularly rapid between 1988 and 1991. The rapidly-growing charterboat fleet is undoubtedly the reason for the recent rapid growth in landings. In 1990, landings of blue marlin exceeded those of all other species for the first time. Landings for 1991 were slightly lower than those of the previous year, and exceeded by landings of mahimahi and skipjack tuna. Some blue marlin were tagged and released during the past two years, and tagging efforts are expected to grow. Sailfish landings have remained insignificant. Virtually all catch was by the trolling method.

Figure 4. Guam annual estimated total landings: skipjack and yellowfin tuna.

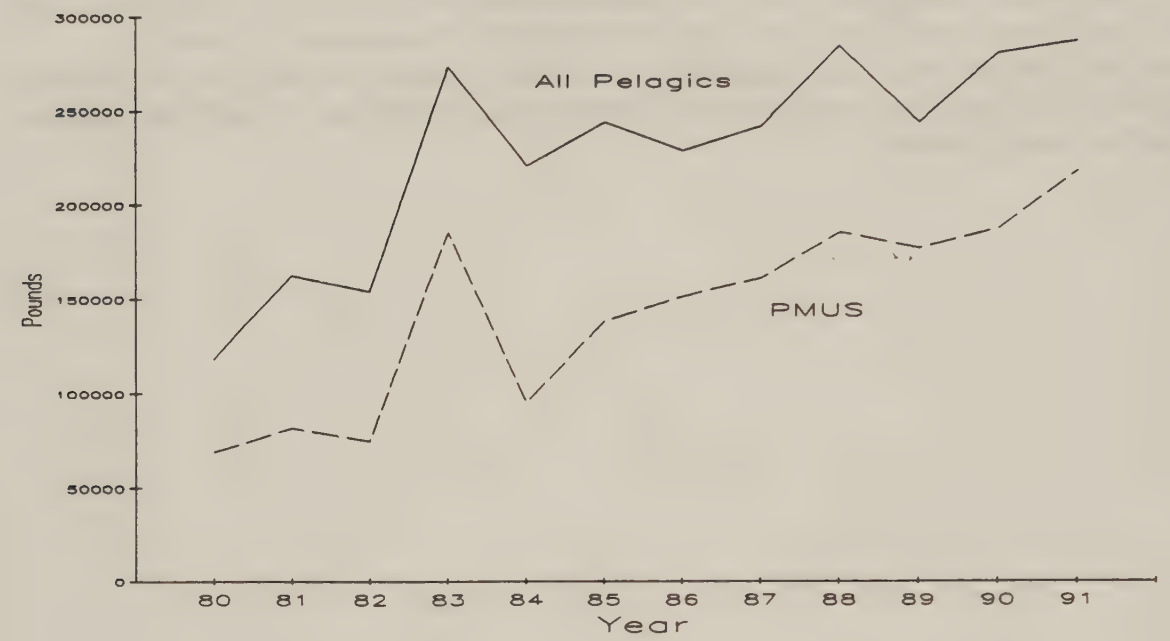


Year	Pounds Landed	
	Skipjack Tuna	Yellowfin Tuna
1980	175,542	49,386
1981	158,493	107,828
1982	137,735	137,202
1983	85,008	65,598
1984	248,243	71,502
1985	137,097	122,707
1986	73,199	47,290
1987	59,228	41,754
1988	184,838	77,434
1989	130,682	34,404
1990	135,993	69,992
1991	133,064	46,443

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. Totals by species are summed across all fishing methods as described in Figure 1.

Interpretation: Landings of skipjack tuna exceeded those of all other species in four of the last 11 years, and were exceeded by mahimahi in all but one of the remaining years. Landings of skipjack tuna have always exceeded those of yellowfin tuna, often by a 2:1 or better ratio. Given the poor marketability of skipjack tuna and the desirability of yellowfin tuna, the availability of skipjack tuna probably exceeds that of yellowfin tuna by a wider margin than this chart would indicate. Virtually all catches are by the trolling method.

Figure 5. Guam annual estimated commercial landings: all pelagics and PMUS.



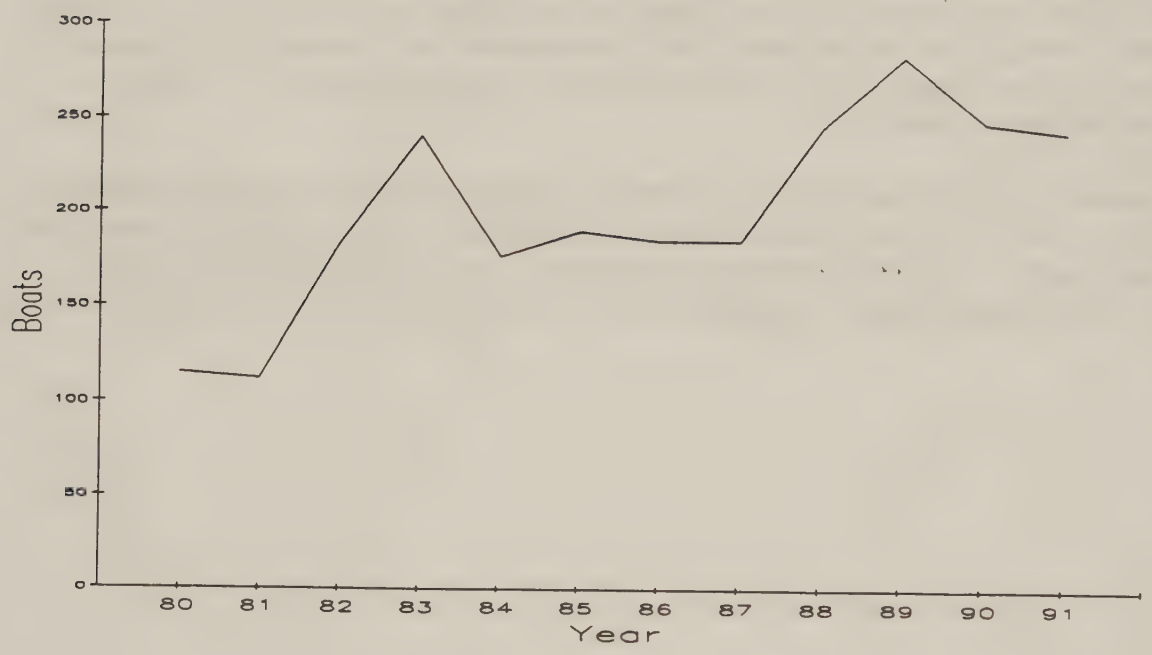
Year	Pounds Landed	
	All Pelagics	PMUS
1980	118,275	69,086
1981	162,186	81,808
1982	153,577	74,832
1983	273,120	184,813
1984	220,074	95,022
1985	243,060	137,422
1986	227,928	150,461
1987	240,790	160,297
1988	283,264	184,493
1989	242,554	175,667
1990	279,121	185,934
1991	285,696	216,611

Source and Calculation: The WPACFIN-sponsored commercial landings data system. The total estimated commercial landings for each year were calculated by summing the weighted fields in the commercial landings database from the principle fish wholesaler on Guam, the Guam Fisherman's Coop, and then multiplying by an estimated percent coverage expansion factor. The annual expansion factor was

subjectively created based on all available information for the year, including (a) an analysis of the "disposition of catch" data available from the DAWR offshore creel survey, (b) an evaluation of the fishermen in the fishery and their entry/exit patterns, (c) general knowledge of the fishery and the status of the marketing conditions and structure, (d) the overall number of records in the data base, and (e) a certain measure of "best guess".

Interpretation: Commercial pelagic landings appear to have increased steadily for the last 12 years. Very few of the fishermen landing fish commercially, however, are full-time fishermen. The growing charterboat industry is certainly adding to the growth of the pelagic fishery because nearly all of the charters are for trolling.

Figure 6. Guam estimated number of trolling boats.

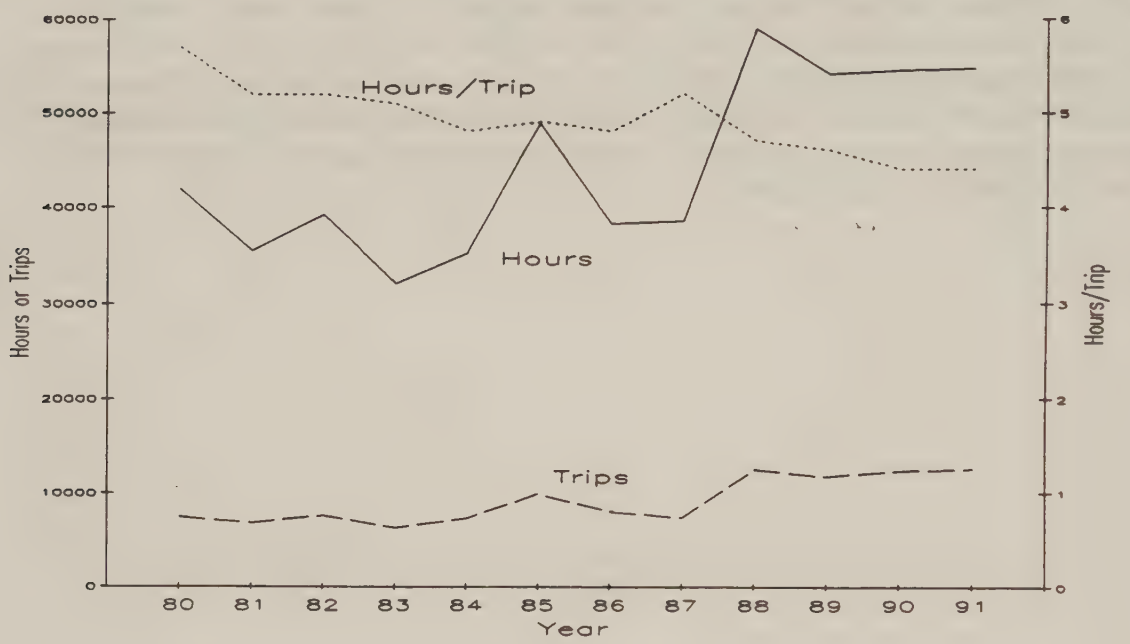


Year	Number of Boats
1980	115
1981	112
1982	183
1983	240
1984	176
1985	189
1986	184
1987	184
1988	245
1989	282
1990	247
1991	242

Source and Calculation: The DAWR offshore creel sampling program and its associated computerized data expansion system files. Because only a fraction of the days of the year are actually sampled, it is not possible to know the exact number of boats participating in the fishery. Therefore, a "threshold" C/E model was run a minimum of 15 times per year. The median estimated number of boats was selected from the sorted list of model estimates.

Interpretation: The figures shown here may be an underestimate since only a single site was sampled for most years, and a second site was sampled on fewer days for the years 1980-81 and 1989-91. There are undoubtedly boats participating in pelagic fisheries that never utilized the sampled sites during any given year. Prior to 1991, this number was probably less than 50 since there were a limited number of launch sites. With the opening of the Agat Marina in 1991, a larger number of boats were not reached by the survey, and the figures given for that year are unrealistically low. There is a general increase in the number of small boats participating in Guam's fisheries over the past 12 years.

Figure 7.
Guam annual estimated pelagic species trips, hours, and hours per trip for trolling.



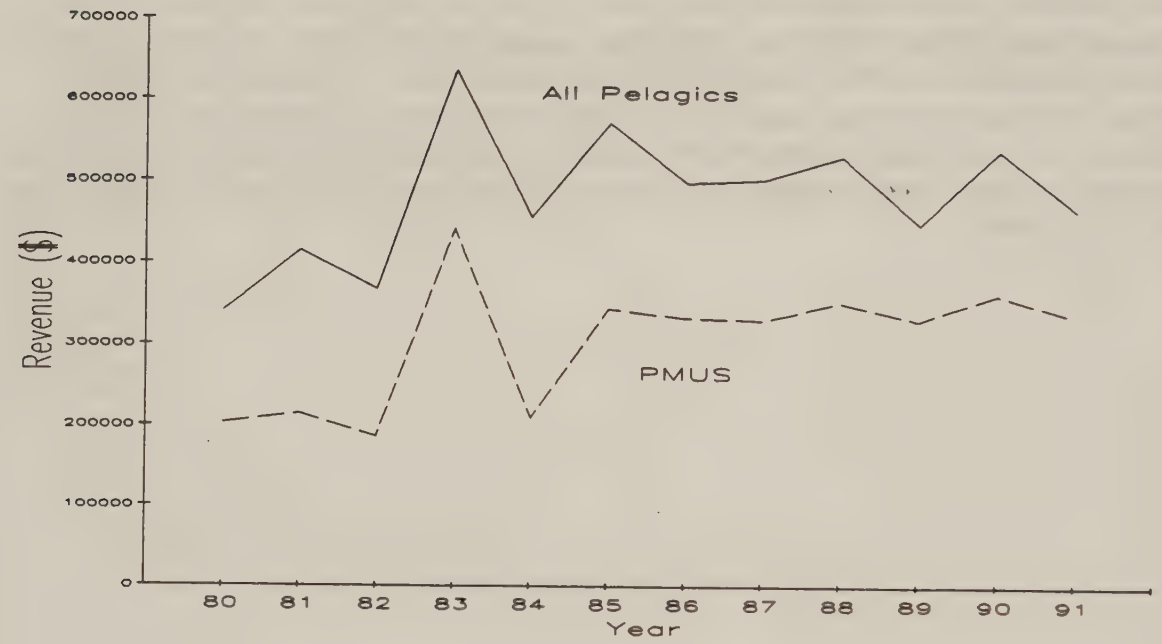
Year	Total Hours	Trips	Hours per Trip
1980	41,870	7,394	5.7
1981	35,430	6,763	5.2
1982	39,146	7,566	5.2
1983	32,085	6,287	5.1
1984	35,196	7,276	4.8
1985	48,823	9,900	4.9
1986	38,201	7,992	4.8
1987	38,475	7,342	5.2
1988	58,874	12,454	4.7
1989	54,119	11,725	4.6
1990	54,486	12,340	4.4
1991	54,686	12,523	4.4

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. These

plots are of the estimated boat hours spent fishing and number of trips for the trolling method as taken directly from creel survey expansion system printouts.

Interpretation: Guam's pelagic fishery is growing, particularly the charter boat segment which has more than doubled during the past few years. The record high effort (boat hours) spent fishing in 1988 was caused by the record high abundance of mahimahi, as well as a rapid expansion of the charter fleet. The leveling off since then could be due to several factors including limited berthing space at the Agana Boat Basin and poor market conditions. Effort is expected to continue its long-term growth. Since most recent charter trips were for a half-day, average trip duration has recently decreased.

Figure 8.
Guam estimated commercial inflation-adjusted total revenues: all pelagics and PMUS.



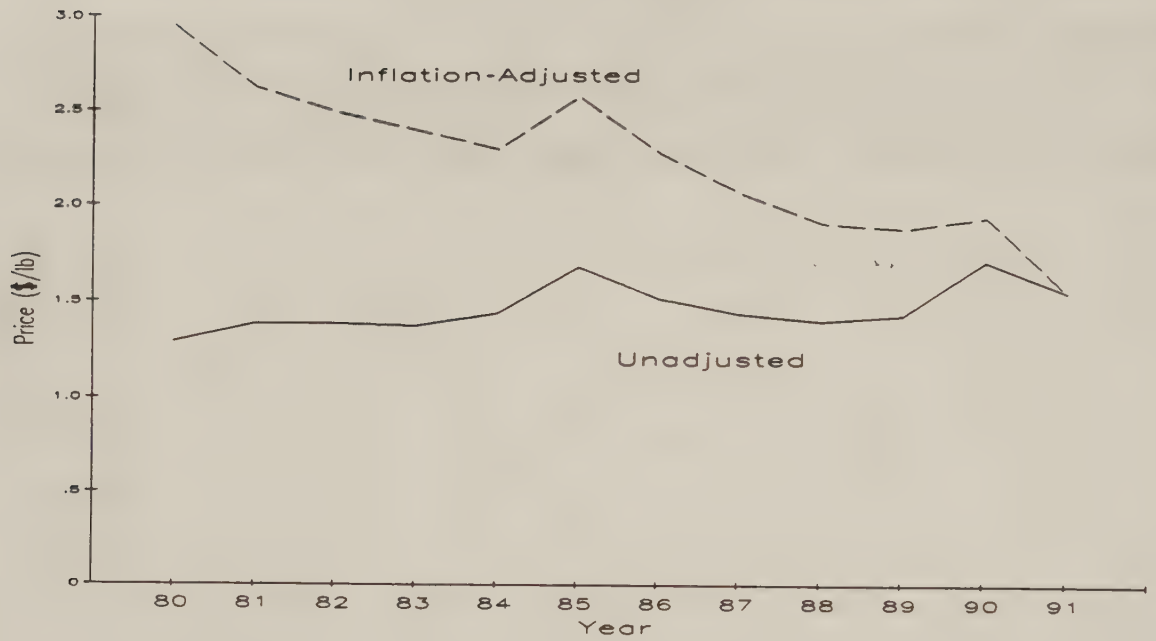
Year	Revenues ($)	
	All Pelagics	PMUS
1980	340,532	202,756
1981	413,838	214,537
1982	367,536	186,537
1983	635,006	441,132
1984	454,526	209,250
1985	569,632	342,896
1986	496,114	332,224
1987	500,069	329,250
1988	528,302	350,463
1989	444,601	328,487
1990	535,330	359,534
1991	462,191	333,096

Source and Calculation: The WPACFIN-sponsored commercial landings system. The total estimated revenue for each year was calculated by summing the revenue fields in the commercial landings data base from the principle fish wholesaler on

Guam, the Guam Fisherman's Coop, and them multiplying by the same percent coverage expansion factor as were the landings in Figure 5.

Interpretation: With the exception of dips in 1989 and 1991, total revenues for all pelagic species as well as PMUS for the past seven years have remained fairly steady. This indicates a declining economic condition of the fishery when one considers that commercial landings for the same period have increased (see Fig. 5).

Figure 9. Guam average price of PMUS.



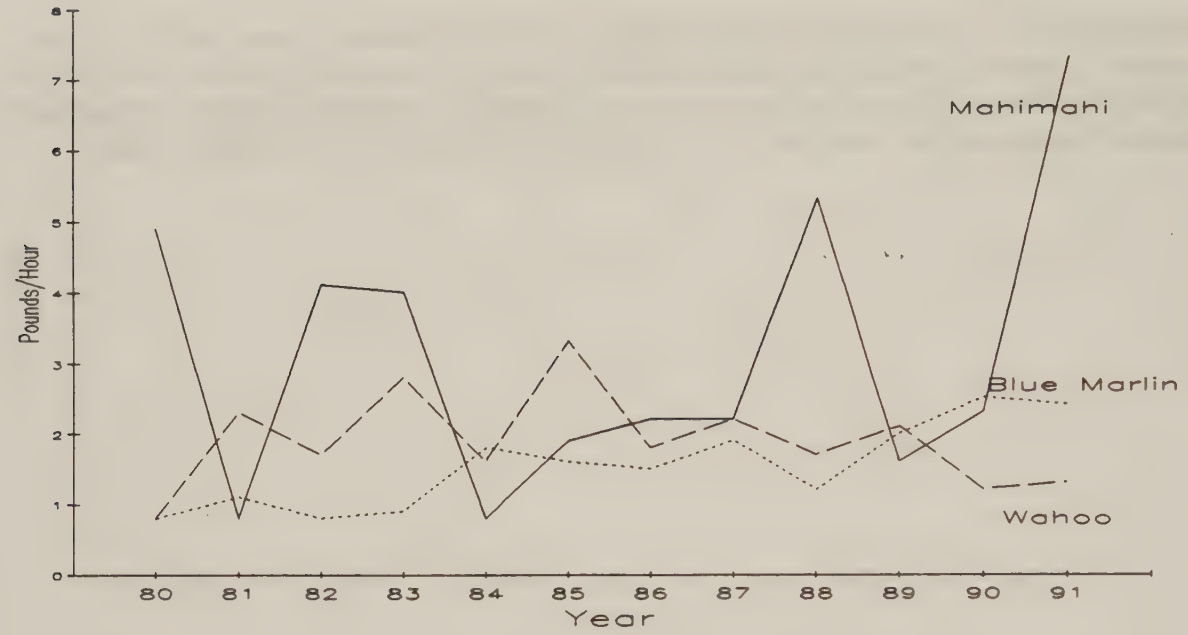
Year	Price ($/lb)	
	Unadjusted	Adjusted
1980	1.29	2.95
1981	1.38	2.62
1982	1.38	2.49
1983	1.37	2.39
1984	1.43	2.29
1985	1.67	2.57
1986	1.51	2.27
1987	1.43	2.06
1988	1.39	1.90
1989	1.42	1.87
1990	1.70	1.93
1991	1.54	1.54

Source and Calculation: The WPACFIN-sponsored commercial landings system. The average price of the PMUS group is calculated by dividing the total revenue for PMUS by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the 1991 figure as the base from which to calculate expansion factors for all previous years (e.g., divide the 1991 CPI by the

CPI of any given year), and then multiplying that factor by the unadjusted average price for the given year.

Interpretation: The inflation-adjusted price of PMUS shows a general decline over the past 12 years. While the decline does not promote a healthy atmosphere for the commercial fishery, it does not necessarily adversely affect the growing charterboat industry, because their success does not directly depend on the price of fish.

Figure 10. Guam trolling catch rates: mahimahi, wahoo and blue marlin.



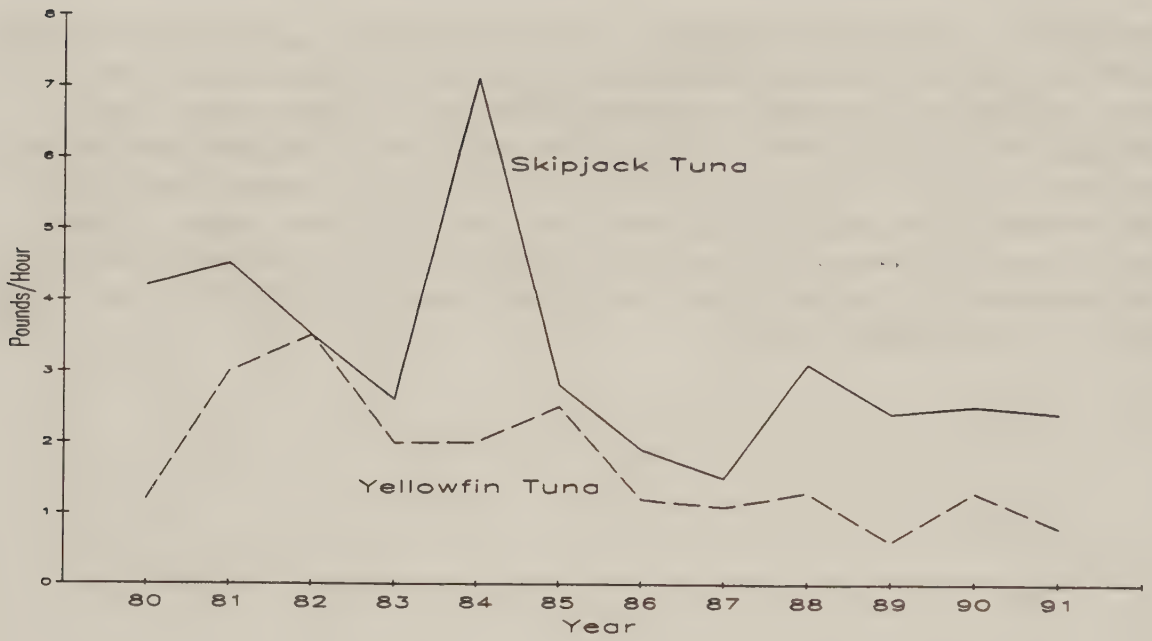
Year	Pounds Caught Per Hour Fished		
	Mahimahi	Wahoo	Blue Marlin
1980	4.9	0.8	0.8
1981	0.8	2.3	1.1
1982	4.1	1.7	0.8
1983	4.0	2.8	0.9
1984	0.8	1.6	1.8
1985	1.9	3.3	1.6
1986	2.2	1.8	1.5
1987	2.2	2.2	1.9
1988	5.3	1.7	1.2
1989	1.6	2.1	2.0
1990	2.3	1.2	2.5
1991	7.3	1.3	2.4

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method. This plot and table of catch per unit of effort (CPUE) are based on the total annual landings of

mahimahi, wahoo, and blue marlin, each divided by the total number of hours spent fishing (gear being used).

Interpretation: The wide fluctuations in CPUE are probably due to the high variability in the year to year abundance and availability of the stocks. Because it is not, however, possible to allocate species-specific effort, effort used to target other species can also result in artificially high or low catch rates for a given species. No general trend in CPUE is apparent for mahimahi or wahoo. However there is a general increase in the catch rate of blue marlin over the 12-year period. This is probably a result of the rapidly growing charter component of the fleet since the charter vessels tend to be larger than average and tend to target marlin more frequently than the smaller boats.

Figure 11. Guam trolling catch rates: skipjack and yellowfin tunas.

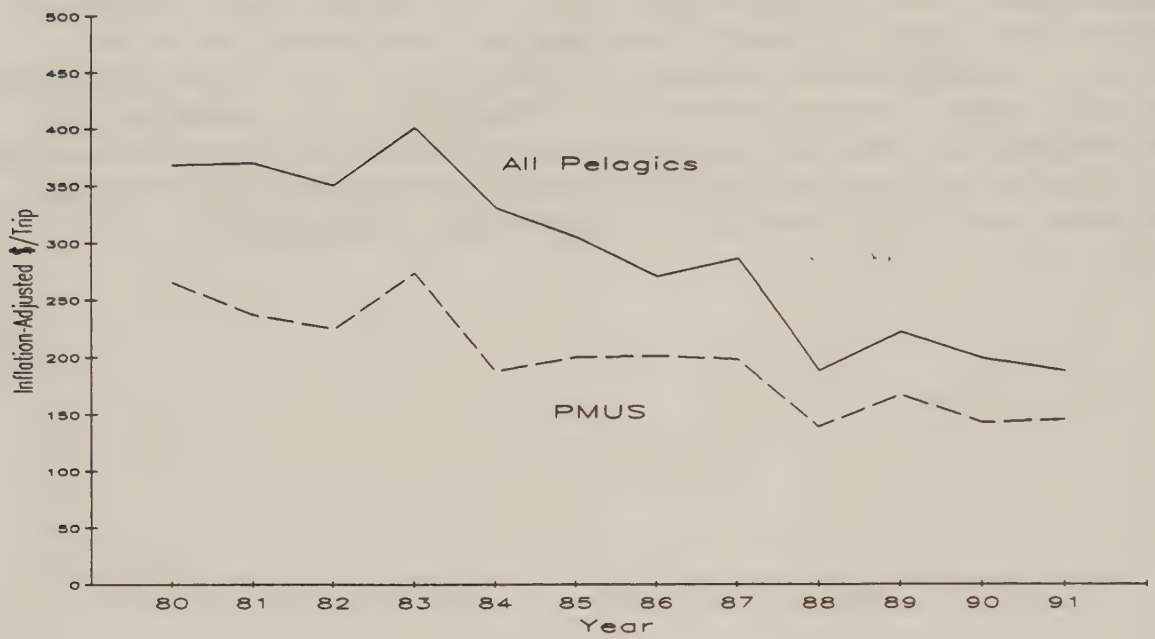


Year	Pounds Caught Per Hour Fished	
	Skipjack Tuna	Yellowfin Tuna
1980	4.2	1.2
1981	4.5	3.0
1982	3.5	3.5
1983	2.6	2.0
1984	7.1	2.0
1985	2.8	2.5
1986	1.9	1.2
1987	1.5	1.1
1988	3.1	1.3
1989	2.4	0.6
1990	2.5	1.3
1991	2.4	0.8

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. The data expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. This plot and table were calculated in the same way as Figure 10.

Interpretation: The wide fluctuations in CPUE for tunas are probably due to the high variability in the year to year abundance and availability of the stocks. There does, however, seem to be a general decline in the CPUE of yellowfin tuna over the past nine years. This could be a result of either declining abundance of the stocks, or decreasing availability due to interception by the purse seine or longline fleets in the Guam EEZ, or both. It is also possible that a large annual effort directed at other trolling species could result in an artificial decline in the CPUE of the species shown here. If the decline is real, restricting purse seine or longline operations from the waters near Guam and its offshore banks might alleviate the problem.

Figure 12. Guam revenues per trolling trip landing PMUS: all pelagics and PMUS.



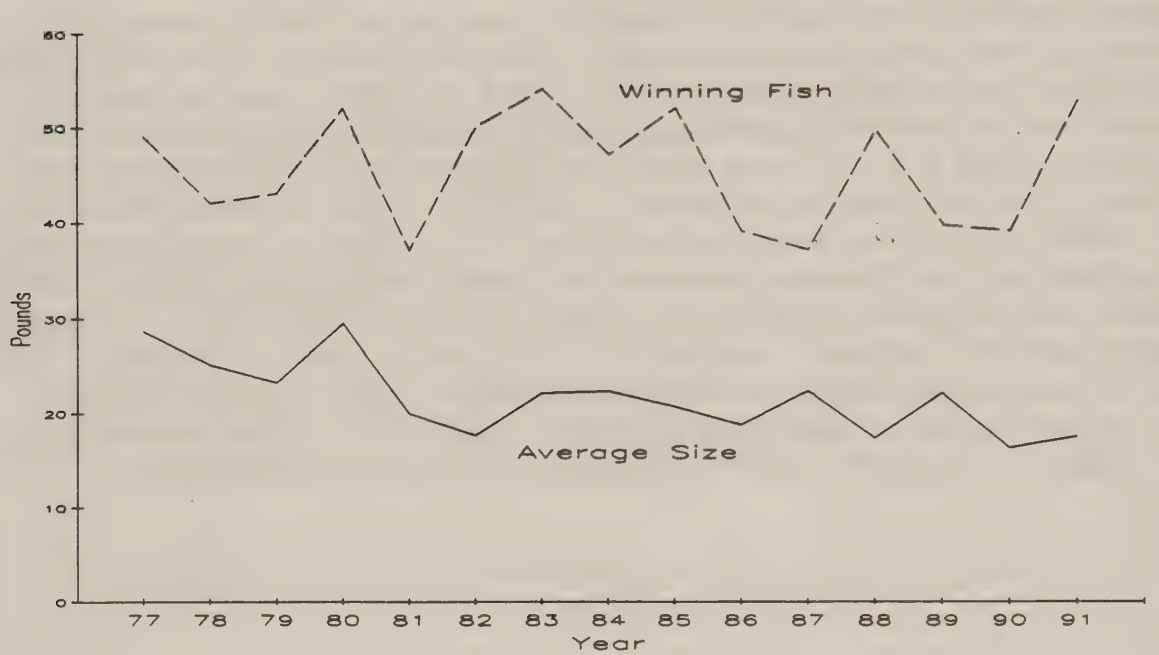
Year	Revenue per Trip ($)			
	All Pelagics		PMUS	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	161	368	116	265
1981	165	370	125	237
1982	194	350	124	224
1983	230	401	157	273
1984	206	330	117	187
1985	197	304	129	199
1986	179	269	133	200
1987	198	285	137	197
1988	137	187	101	138
1989	167	220	126	166
1990	173	197	124	141
1991	186	186	144	144

Source and Calculation: The WPACFIN-sponsored commercial landings system. The average revenue per trip is calculated by summing the revenue of all species sold then dividing by the number of trips, and summing the revenue of all PMUS sold then dividing by the number of trips, respectively, for any trip which landed any

PMUS. Adjusted revenue per trip is derived from the Guam annual Consumer Price Index (CPI), using 1978 as the base year.

Interpretation: Adjusted revenue per trip for all species and PMUS have experienced a general decline during the past 12 years. One must be careful in interpreting these data for the Guam fishery because they are subject to biases created by marketing problems, and the market structure upon which the data collecting system is based. For instance, 1988 and 1991 were record high years for abundance and landings of mahimahi. One might expect the per-trip landings to be high for a year which had record landings, but because of the glut on the market during the mahimahi season, and because of other marketing problems, the per-trip revenue was unusually low. This was partly because purchase limits were placed on fishermen, e.g., only certain fishermen's (Coop members') catches would be purchased, and a 50-lb/person maximum sales limit was often in place for mahimahi. This caused fishermen to either stop fishing at all, stop fishing when they caught 50 lb, or start marketing some of their catch as elsewhere, all of which aggravated Coop market problems.

Figure 13. Guam International Fishing Derby - average size and size of winning fish: wahoo.



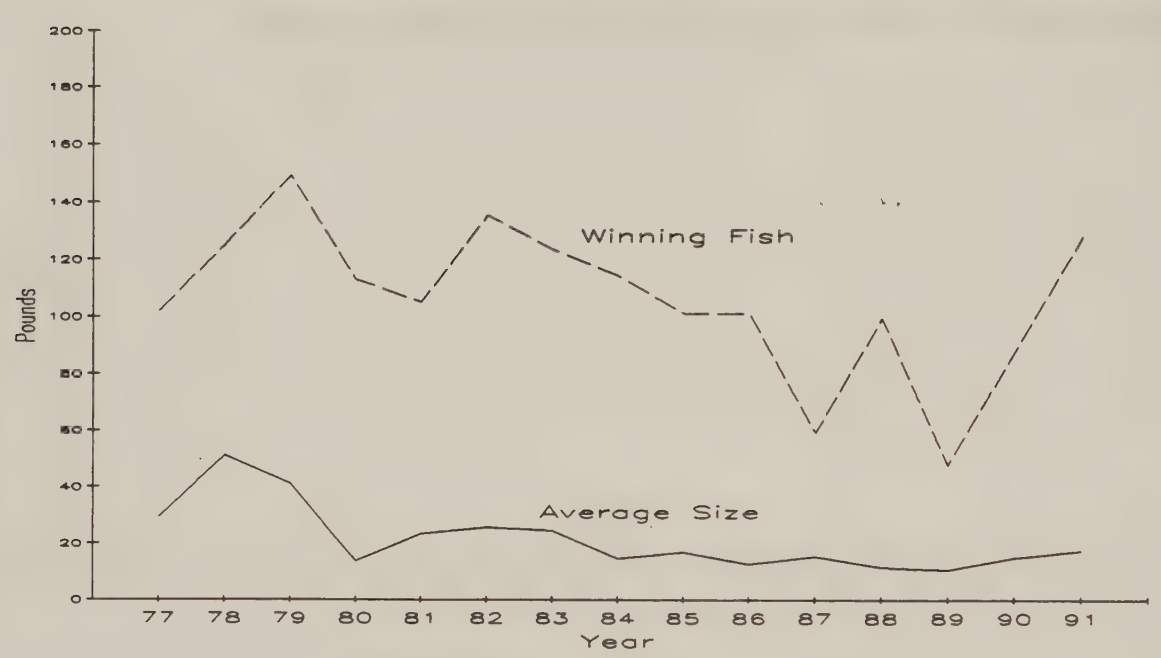
Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	7	28.7	49
1978	9	25.1	42
1979	11	23.2	43
1980	12	29.5	52
1981	60	20.0	37
1982	33	17.6	50
1983	36	22.1	54
1984	46	22.3	47
1985	98	20.7	52
1986	16	18.7	39
1987	31	22.3	37
1988	72	17.3	49.5
1989	59	22.0	39.5
1990	34	16.2	38.9
1991	40	17.4	52.9

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) annual reports. The Guam International Fishing Derby (GIFD) is an annual 3-day

event that takes place in July or August. Most of the wahoo caught are measured or weighed by derby officials. The figures here include some fishes whose weights are based on an average or estimate.

Interpretation: No general trend is apparent over the last 15 years.

Figure 14.
Guam International Fishing Derby - average size and size of winning fish: yellowfin tuna.

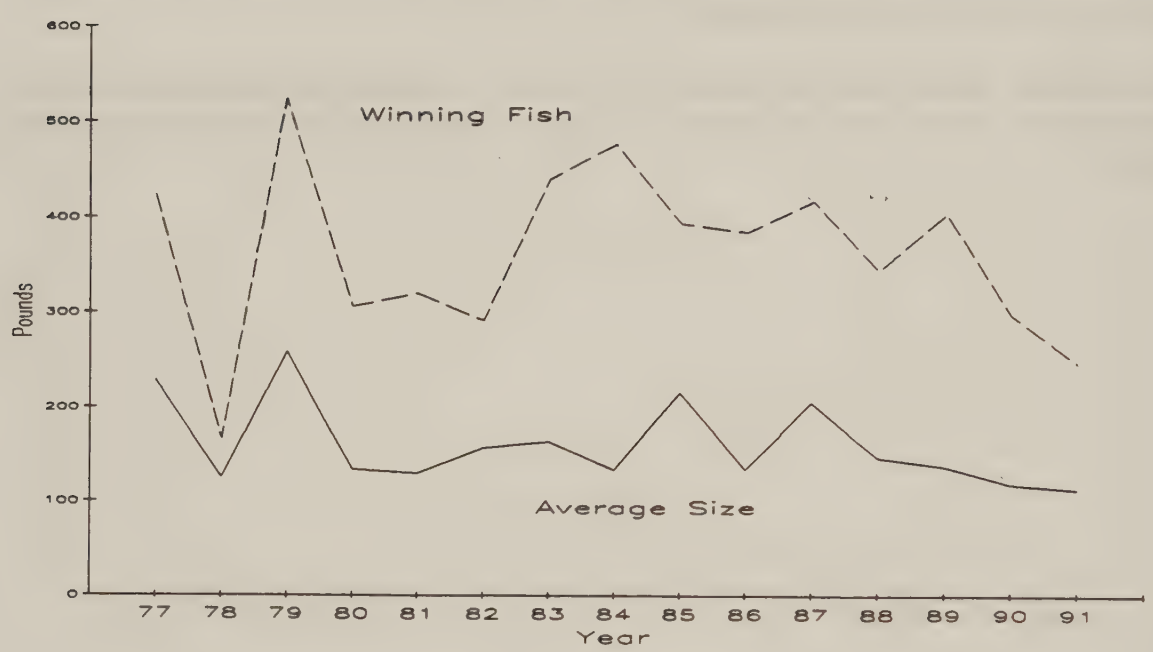


Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	18	29.3	102
1978	11	51.2	125
1979	34	41.2	149
1980	50	13.7	113
1981	109	23.4	105
1982	205	25.6	135
1983	100	24.5	123
1984	59	14.6	114
1985	137	17.0	101
1986	71	12.6	101
1987	116	15.3	59
1988	161	11.6	99
1989	81	10.5	47.5
1990	81	14.9	88
1991	102	17.4	127.4

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) annual reports. The Guam International Fishing Derby (GIFD) is an annual 3-day event that is run in July or August. Most of the yellowfin tuna caught are measured or weighed by derby officials. The figures here include some fishes whose weights are based on an average or estimate.

Interpretation: There seems to be a slight recovery in average size and size of the winning fish during the last two years following a general decline during the previous 10 years.

Figure 15.
Guam International Fishing Derby - average size and size of winning fish: blue marlin.



Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	9	228.4	423
1978	9	125.2	166
1979	6	258.4	523
1980	12	133.6	306
1981	34	130.1	320
1982	12	156.6	291
1983	13	163.6	439
1984	47	133.2	475
1985	17	215.2	392
1986	47	134.1	383
1987	43	203.9	415
1988	58	145.7	342.5
1989	86	136.7	402
1990	64	117.9	295
1991	61	112.0	245

Source and Calculation: The Division of Aquatic and Wildlife Resources (DAWR) annual reports. The Guam International Fishing Derby (GIFD) is an annual 3-day event that takes place in July or August. Most of the billfishes caught are measured or weighed by derby officials. The figures here may include a few fishes whose weights are based on an average or estimate.

Interpretation: No general trend is apparent over the last 15 years, but the size of the winning fish and average size have decreased over the last three and four years, respectively.

Appendix 3

State of Hawaii - Part A

(includes longline and other pelagic gear)

Introduction

This report contains information from two sources: Walter Ikehara of the Hawaii Division of Aquatic Resources (HDAR) provided detailed breakdowns of troll and handline catch statistics from the State of Hawaii commercial fish catch reporting system. Russell Ito and Sam Pooley of the National Marine Fisheries Service (NMFS) provided detailed breakdowns of longline catch statistics from the NMFS longline logbook program and the NMFS & HDAR wholesale market monitoring program. Figures on pelagic landings were constructed by NMFS using an estimation procedure explained more fully in the NMFS annual report on Hawaii's pelagic fishery (ref.).

Scientific names for individual species, including those included in the "other" categories, are listed in Table 3.

Appendix 4 contains the State of Hawaii's report on non-longline pelagic catches, as well as a summary of the 1991 Hawaii fishery, and recommendations.

Table 1a. Hawaii domestic pelagic landings: 1991.

Species	Pounds Landed	Revenue ($)	Price ($/lb)
Blue Marlin	1,254,743	1,069,061	0.91
Black Marlin	20,837	23,675	1.34
Striped Marlin	1,542,515	1,481,976	0.98
Spearfish	423,840	361,531	0.87
Sailfish	31,388	24,453	0.82
Swordfish	9,599,276	21,413,145	2.23
Other Billfish	7	0	0.00
Subtotal Billfishes	12,872,605	24,373,841	1.91
Sharks	229,933	129,728	0.59
Mahimahi	2,161,586	3,514,395	1.70
Wahoo	436,970	912,181	2.18
Subtotal PMUS	**15,701,094**	**28,930,144**	**1.87**
Bluefin Tuna	4,424	33,546	7.58
Bigeye Tuna	4,183,286	13,395,453	3.21
Yellowfin Tuna	2,666,660	6,162,457	2.34
Albacore	732,716	958,298	1.31
Skipjack Tuna	2,558,262	3,201,251	1.28
Kawakawa	8,440	9,585	1.55
Other Tunas	1,338	1,016	1.06
Subtotal Tunas	**10,155,126**	**23,761,606**	**2.37**
Other Pelagics	410,477	591,007	1.45
Total Pelagics	**26,266,698**	**53,282,758**	**2.03**

Table 1b. Hawaii domestic pelagic landings: 1990.

Species	Pounds	Revenue	Price($/lb)
Blue Marlin	1,316,174	1,131,988	0.97
Black Marlin	17,108	12,305	0.82
Striped Marlin	1,245,108	1,563,485	1.35
Spearfish	136,001	171,943	1.34
Sailfish	10,313	9,000	0.97
Swordfish	4,194,719	6,704,732	2.31
Other Billfish	9,433	4,924	0.52
Subtotal Billfishes	6,928,857	9,598,377	1.78
Sharks	223,347	119,437	0.61
Mahimahi	1,424,342	2,839,303	2.13
Wahoo	321,676	751,061	2.46
Subtotal PMUS	**8,898,222**	**13,308,178**	**1.84**
Bluefin Tuna	2,236	874	1.25
Bigeye Tuna	3,614,618	11,295,966	3.36
Yellowfin Tuna	3,394,635	7,331,911	2.30
Albacore	376,621	544,748	1.50
Skipjack Tuna	1,141,577	1,987,924	1.84
Kawakawa	10,804	9,960	1.23
Other Tunas	742	304	1.05
Subtotal Tunas	**8,541,234**	**21,171,687**	**2.65**
Other Pelagics	385,740	551,789	1.45
Total Pelagics	**17,825,194**	**35,031,654**	**1.97**

Source and Calculation: NMFS estimates based on shoreside monitoring by NMFS and HDAR. Totals are calculated by summing separate estimates for longline, pole-and-line (baitboat or akuboat, main Hawaiian Islands (MHI) troll and handline, and Northwestern Hawaiian Islands (NWHI) landings. Detailed information on the estimation procedure is available in the NMFS annual report on the pelagics fishery. Price is

calculated as Revenue divided by Pounds Sold (not shown). The columns may not add up precisely due to rounding.

Adjustment: Totals for 1990 were revised slightly from last year's annual report for two reasons. First, NMFS estimates of longline landings were revised upward slightly, with a slight change in species composition, particularly in terms of swordfish landings. Second, NMFS estimates of MHI troll and handline landings were revised downward slightly due to corrections in gear allocation in the NMFS & HDAR shoreside monitoring data.

Interpretation: Reserved for detailed gear and species breakdowns in subsequent figures.

Table 2. Average size of individual fish (pounds), by gear type: 1987-91.

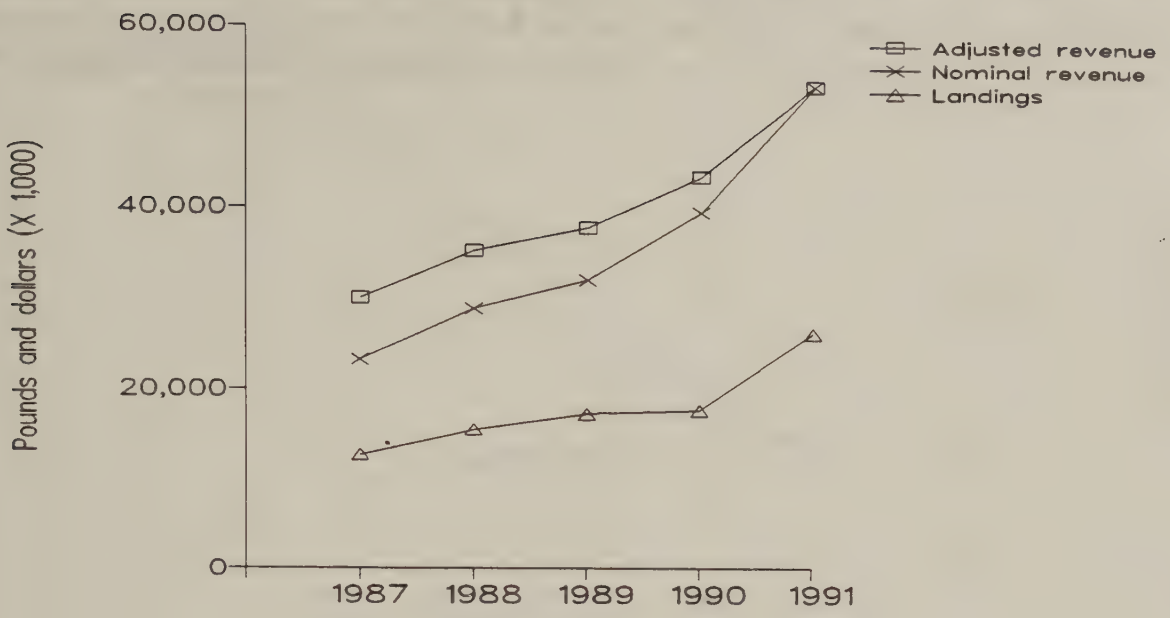
Year	Pelagic Mangagement Unit Species (PMUS)					Tunas			
	Swordfish	Blue Marlin	Striped Marlin	Mahimahi	Wahoo	Bigeye Tuna	Yellowfin Tuna	Albacore	Skipjack Tuna
Longline									
1987	129.3	161.4	66.2	21.1	33.3	76.3	81.9	62.3	--
1988	119.2	157.3	56.9	20.0	31.9	83.2	102.5	59.7	--
1989	131.1	164.7	61.5	23.0	34.6	77.0	103.7	62.0	--
1990	147.6	198.4	61.5	18.7	36.0	79.8	121.9	61.2	--
1991	142.4	172.0	55.8	14.5	31.6	85.5	117.2	53.3	--
Troll and Handline (Oahu only)									
1987	--	212.1	67.3	18.8	19.5	19.6	27.6	--	8.9
1988	--	181.6	60.3	17.2	21.1	28.9	31.5	--	11.1
1989	--	185.7	67.9	19.9	20.9	34.0	35.4	--	13.6
1990	--	243.3	74.8	19.1	21.9	25.3	51.6	--	10.6
1991	--	179.2	60.6	13.5	18.8	20.4	26.0	--	14.5

Source and Calculation: NMFS & HDAR shoreside monitoring. Longline average size (in pounds) constructed by a simple mean of total fish sampled. Troll and handline average size constructed from Oahu landings only.

Table 3. Major commercial pelagic species in Hawaii

Common name	Scientific name
Pelagic Management Unit Species	
Black marlin	*Makaira indica*
Blue marlin	*M. mazara*
Striped marlin	*Tetrapturus audax*
Indo-Pacific sailfish	*Istiophorus platypterus*
Shortbill spearfish	*T. angustirostris*
Swordfish	*Xiphias gladius*
Mahimahi	*Coryphaena hippurus*
Wahoo (Ono)	*Acanthocybium solandri*
Mako shark (short-fin)	*Isurus oxyrinchus*
Mako shark (long-fin)	*I. paucus*
Oceanic whitetip shark	*Carcharhinus longimanus*
Thresher shark	*Alopias superciliosus*
Tiger shark	*Galeocerdo cuvieri*
Tunas	
Albacore	*Thunnus alalunga*
Bigeye tuna	*T. obesus*
Bluefin tuna	*T. thynnus*
Kawakawa	*Euthynnus affinis*
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*T. albacares*
Other Pelagics	
Barracuda	*Sphyraena barracuda*
Moonfish (opah)	*Lamprus regius*
Oilfish (smooth)	*Lepidocybium flavobrunneum*
Oilfish (rough)	*Ruvettus pretiosus*
Pomfrets	family *Bramidae*
Raftfish	*Hyperglyphae japonica*

Figure 1. Hawaii pelagic landings and revenue: 1987-91.

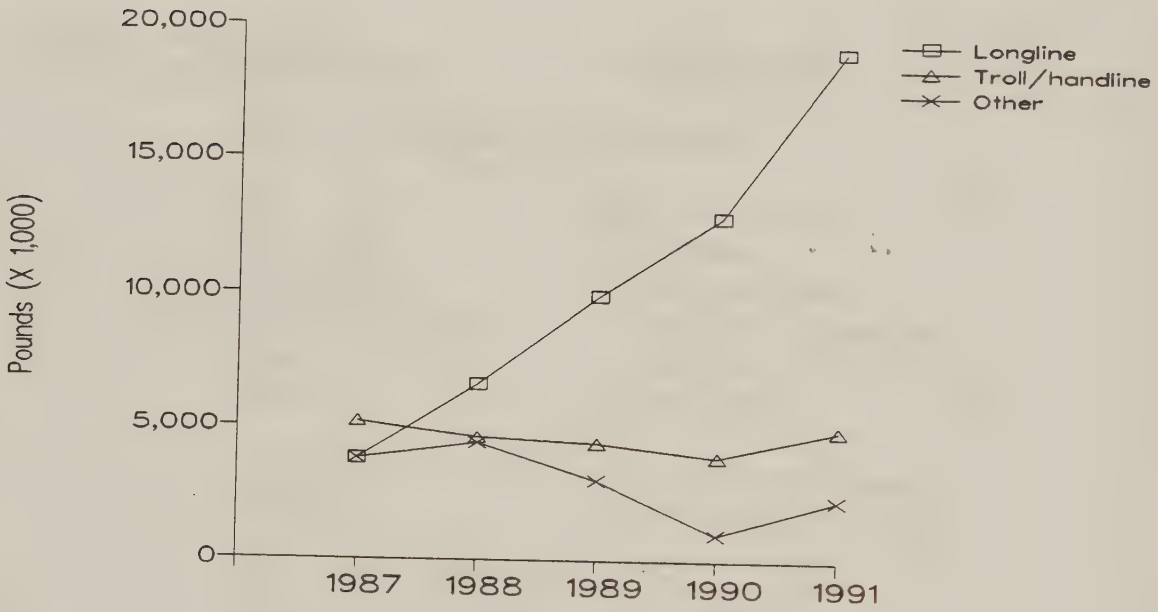


Year	Pounds (x 1000)	Revenue (x $1000)	
		Nominal	Inflation-Adjusted
1987	12,800	23,300	30,100
1988	15,600	28,900	35,300
1989	17,300	32,000	37,800
1990	17,700	39,500	43,500
1991	26,200	53,500	53,500
Average	17,900	35,400	40,000

Source and Calculation: Landings and revenue data are collected by the NMFS & HDAR market monitoring program. See notes to Table 1 for estimation procedures. Nominal revenue is converted to inflation-adjusted revenue with the 1991 Honolulu Consumer Price Index. Estimates are rounded to the nearest 100,000 lb or dollars. The numbers may not add up due to rounding.

Interpretation: Total landings of Hawaii's pelagic fishery increased by 48% in weight and 35% in revenue from the previous year. The figure shows a 105% increase in landings, a 130% increase in nominal revenue, and a 78% increase in inflation-adjusted revenue over the 5-year period.

Figure 2. Hawaii total pelagic landings by gear type: 1987-91.



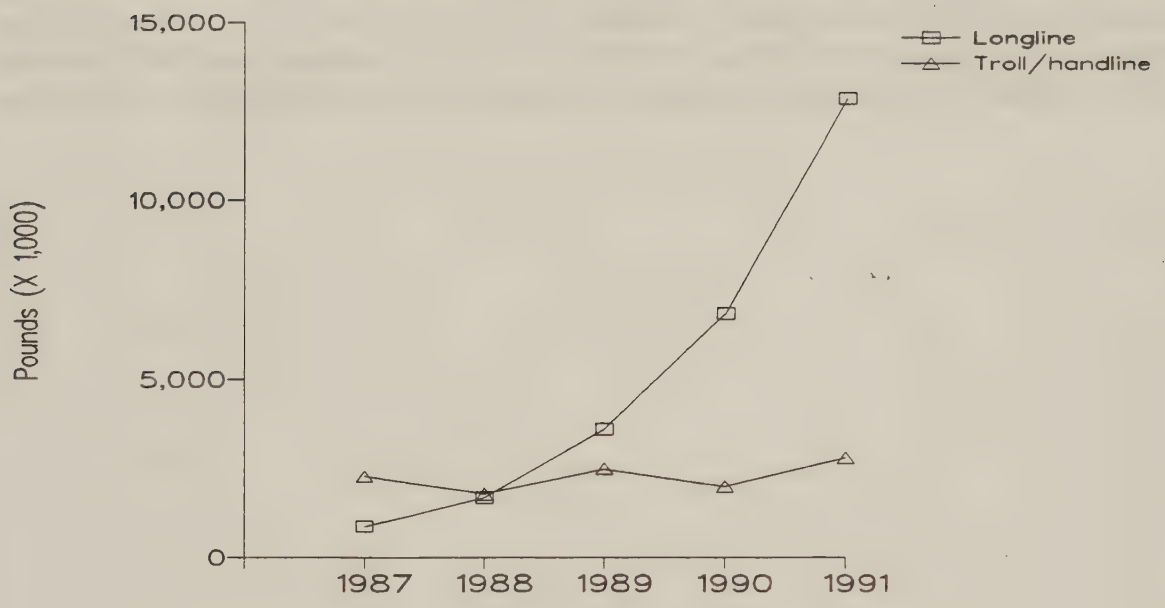
Year	Pounds Landed (x 1000)		
	Longline	Troll & Handline	Other Gear
1987	3,800	5,200	3,800
1988	6,600	4,600	4,400
1989	9,900	4,400	3,000
1990	12,800	3,900	1,000
1991	19,000	4,900	2,300
Average	10,400	4,600	2,900

Source and Calculation: Landings data are collected by the NMFS & HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Longline landings increased 48% in 1991. Troll and handline landings increased 26% in 1991. Other gear types (mainly baitboat landings) increased by 130% in 1991. Longline landings have increased 400% during the 5-year period. Troll and handline landings decreased 25% from 1988-90, and increased in 1991. Other gear type landings decreased 77% from 1988-90 and increased in 1991.

Much of the increase in longline landings is due to swordfish. Swordfish landings increased from negligible catches in 1987 to 9.6 million lb in 1991. Most of the increased landings by trollers and handliners is due to mahimahi. Mahimahi landings increased from 500,000 lb in 1988 to 1.6 million lb in 1991. Baitboat (akuboat) landings, composed mostly of skipjack tuna, account for most of the landings in other gear types.

Figure 2a. Hawaii PMUS landings by gear type: 1987-91.



Year	Pounds Landed (x 1000)	
	Longline	Troll & Handline
1987	900	2,300
1988	1,700	1,800
1989	3,600	2,500
1990	6,800	2,000
1991	12,800	2,800
Average	5,200	2,300

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: PMUS landings by longline and troll and handline gear types increased 88% and 40% respectively in 1991. Longline PMUS landings increased by 14 times during the 5-year period. Troll and handline PMUS landings were static during 1987-91.

Almost all of the PMUS in the troll and handline category are caught by trollers. Although the handline catch is low in PMUS, it was included in the same gear category because there was no way to differentiate the two gear types based on the present market monitoring methods. Much of the increase in PMUS landings by longliners is due to swordfish. Swordfish landings increased from negligible catches in 1987 to 9.6 million lb in 1991.

Figure 2b. Hawaii tuna landings by gear type: 1987-90.

Year	Pounds Landed (x 1000)		
	Longline	Pole-and-Line	Troll & Handline
1987	2,700	3,600	2,900
1988	4,700	4,300	2,800
1989	5,900	2,800	1,900
1990	5,600	1,000	1,900
1991	5,800	2,200	2,100
Average	4,900	2,800	2,300

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Longline and troll and handline tuna landings increased by a modest 4% and 11% respectively while pole-and-line (baitboat, akuboat) tuna landings increased more dramatically (up 130%) from 1991. Longline tuna landings increased dramatically from 1987-89 (up 119%). Pole-and-line tuna landings have shown a steady decline since 1988 but increased in 1991. Troll and handline tuna landings decreased by 34% from 1987-89 and changed slightly thereafter. Troll and handline landings in 1989-91 are much lower than landings of 1987-88 levels.

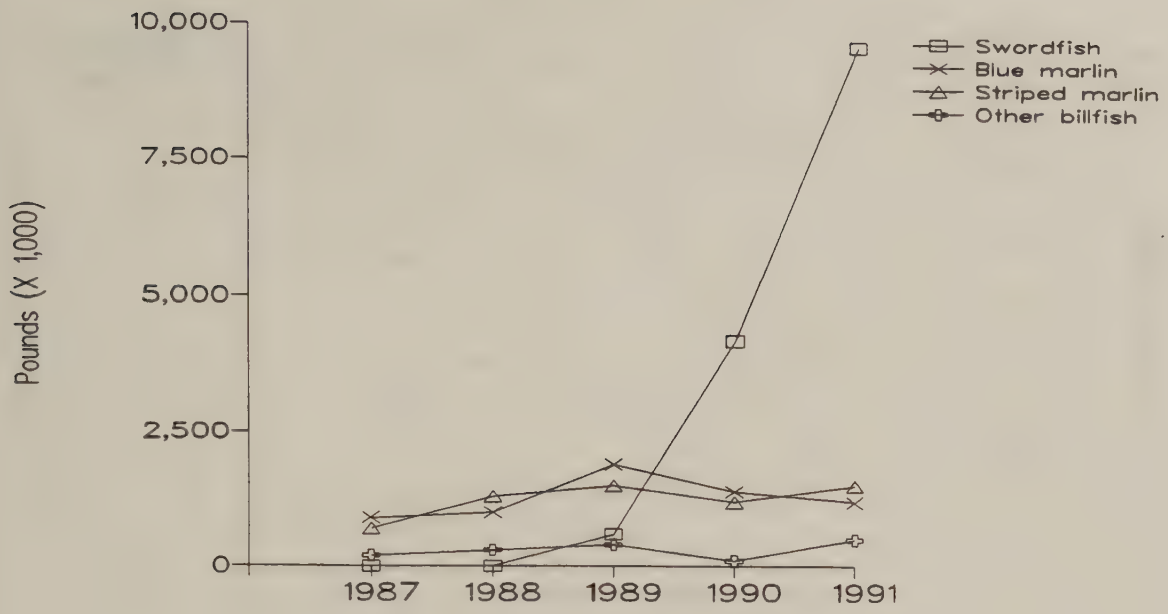
Figure 3. Hawaii PMUS landings and revenue: 1987-91.

Year	Pounds (x 1000)	Revenue (x $1000)	
		Nominal	Inflation-Adjusted
1987	3,300	5,700	7,400
1988	3,600	5,800	7,100
1989	6,100	7,900	9,300
1990	8,800	16,400	18,000
1991	15,600	29,000	29,000
Average	7,500	13,000	14,200

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: PMUS increased by 77% in weight and revenue from the previous year. The figure shows a 373% increase in landings, a 409% increase in nominal revenue, and a 292% increase in inflation-adjusted revenue over the 5-year period. Much of the increase in the PMUS category is due to swordfish landings. Swordfish landings increased from negligible landings to 9.6 million lb in 1991.

Figure 4. Species composition of Hawaii billfish landings: 1987-91.



Year	Pounds Landed (x 1000)			
	Swordfish	Blue Marlin	Striped Marlin	Other Billfish
1987	0	900	700	200
1988	0	1,000	1,300	300
1989	600	1,900	1,500	400
1990	4,200	1,400	1,200	100
1991	9,600	1,200	1,500	500
Average	2,900	1,300	1,200	300

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Swordfish landings increased by 129% in 1991. Blue marlin landings decreased 14% while striped marlin and other billfish (shortnosed spearfish, black marlin, and sailfish) landings increased 25% and 400% respectively in 1991. Landings of swordfish showed the largest increase over the 5-year period increasing 16 times the landings in 1989. Blue marlin landings peaked in 1989 while striped marlin landings peaked at 1.5 millions lb in 1989 and 1991. Although landings of other billfish (shortnosed spearfish, black marlin, and sailfish) increased substantially, the volume is low in comparison to the major billfish species. Longliners targeting swordfish have greatly affected landings of swordfish.

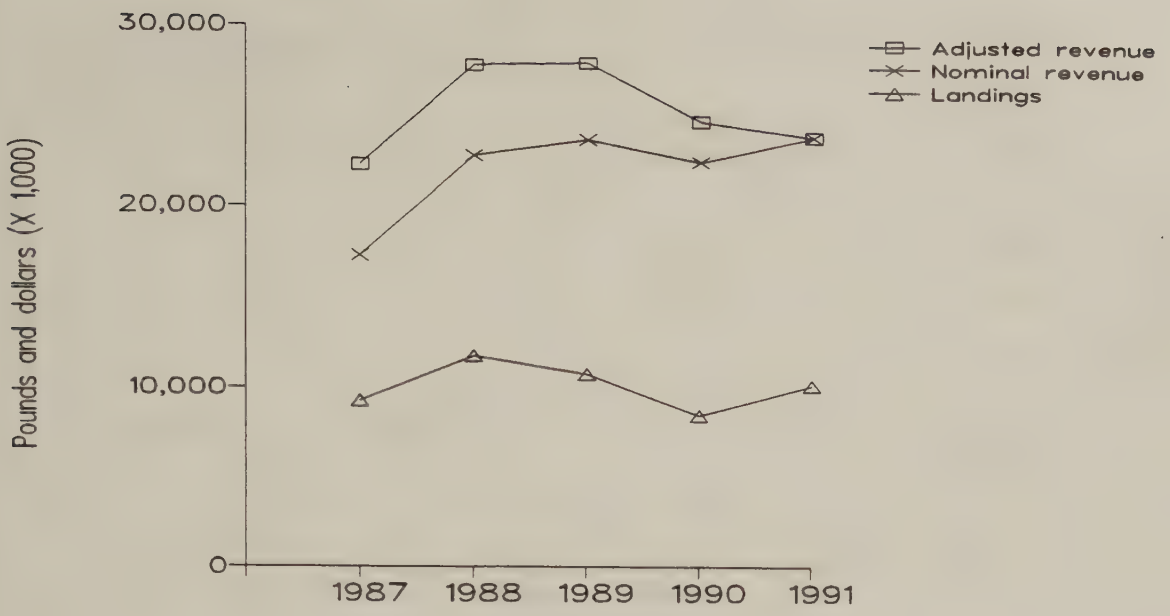
Figure 5. Species composition of other Hawaii PMUS landings: 1987-91.

Year	Pounds (x 1000)		
	Mahimahi	Wahoo (ono)	Sharks
1987	1,000	500	0
1988	500	400	100
1989	1,100	400	200
1990	1,400	300	200
1991	2,200	400	200
Average	1,200	400	100

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Mahimahi and wahoo (ono) landings have increased 57% and 33% respectively while shark (mostly thresher and mako sharks) landings remained the same in 1991. Mahimahi landings have increased 340% since 1988. Wahoo (ono) landings decreased 40% from 1987 to 1990 and increased in 1991. Landings of sharks increased from negligible amounts to 200,000 lb during 1987-91. Mahimahi and wahoo are caught mostly by trollers. The increase in shark landings is attributable to the substantial catch of sharks in the longline swordfish fishery.

Figure 6. Hawaii tuna landings and revenue: 1987-91.

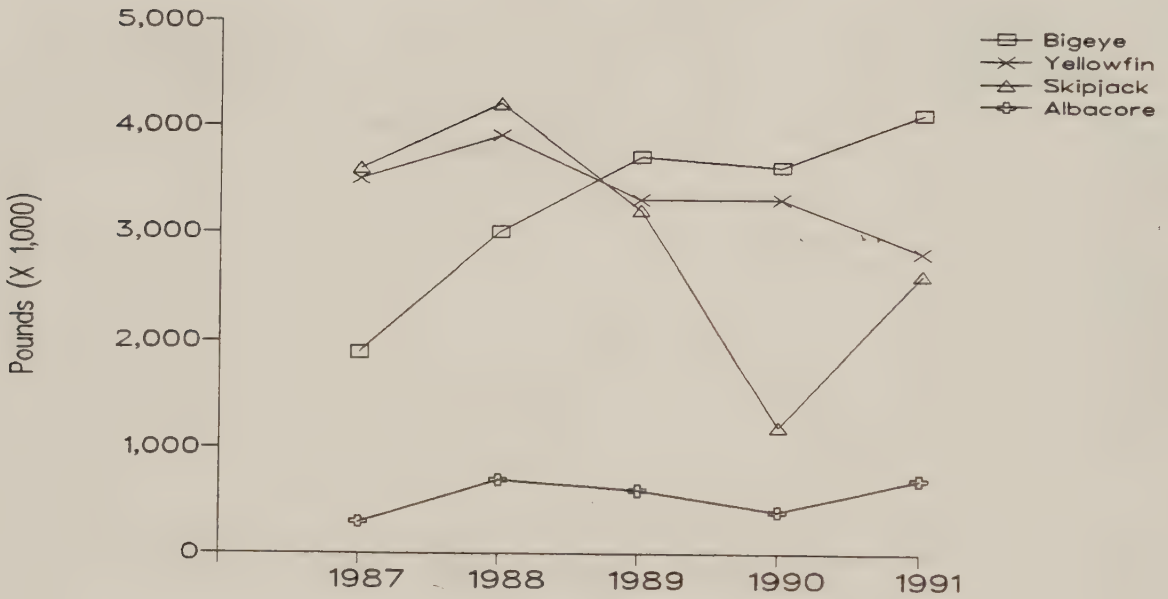


Year	Pounds (x 1000)	Revenue (x $1000)	
		Nominal	Inflation-adjusted
1987	9,300	17,300	22,300
1988	11,800	22,800	27,800
1989	10,800	23,700	28,000
1990	8,500	22,500	24,800
1991	10,200	23,900	23,900
Average	10,100	22,000	25,400

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Tuna landings increased 20% in weight and 6% in revenue respectively from 1990. The figure shows no dramatic change in landings and revenue over the 5-year period.

Figure 7. Species composition of Hawaii tuna landings: 1987-91.

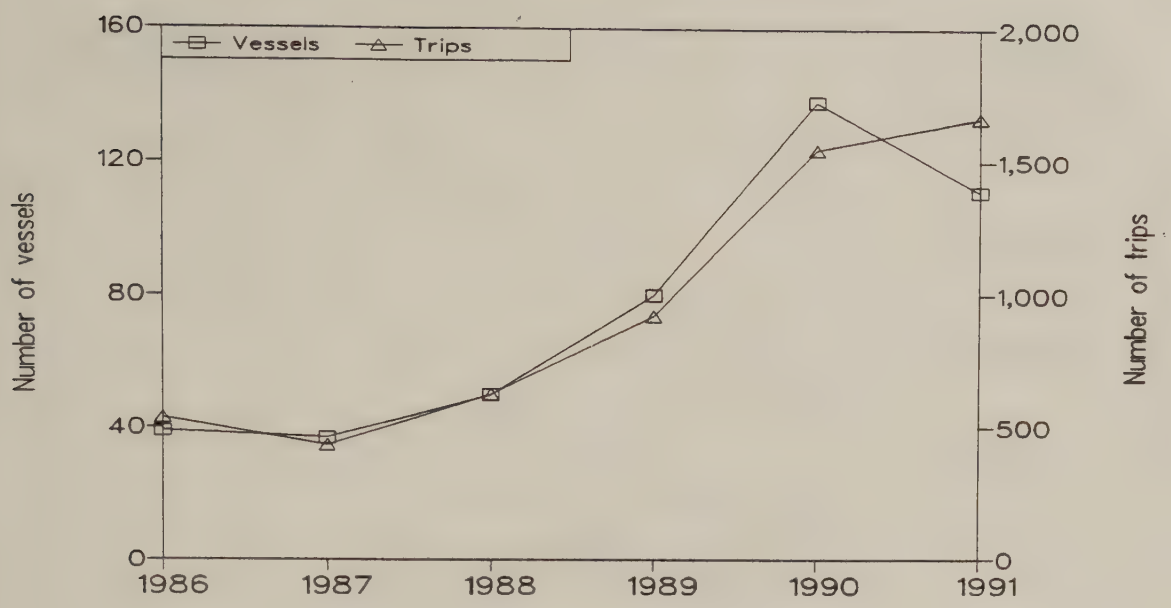


Year	Pounds Landed (x 1000)			
	Bigeye	Yellowfin	Skipjack	Albacore
1987	1,900	3,500	3,600	300
1988	3,000	3,900	4,200	700
1989	3,700	3,300	3,200	600
1990	3,600	3,300	1,200	400
1991	4,100	2,800	2,600	700
Average	3,300	3,400	3,000	500

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Bigeye, skipjack, and albacore tuna landings increased (up 14%, 117%, and 75% respectively) while yellowfin tunas decreased (down 15%) from 1990. Bigeye tuna increased 116% during the 5-year period while skipjack and albacore tuna landings declined during 1988-90 and showed a increase in 1991. Landings of yellowfin tuna have decreased 28% since 1988.

Figure 8. Hawaii longline vessel activity: 1986-91.

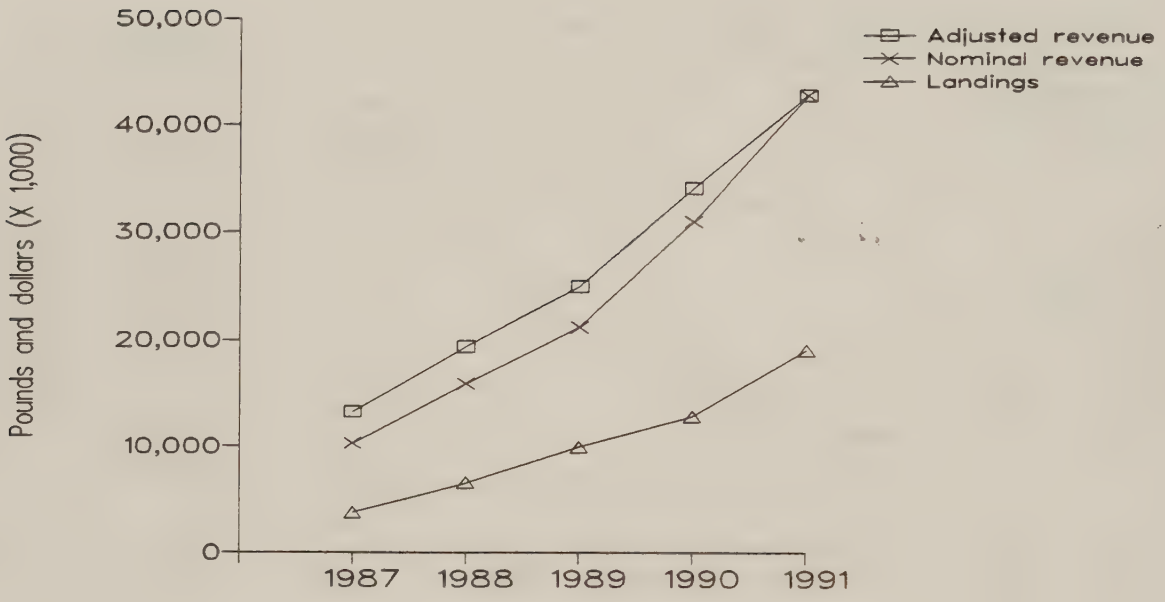


Year	Active Vessels	Trips
1986	39	537
1987	37	435
1988	50	627
1989	80	923
1990	138	1546
1991	111	1665

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. Longline vessel monitoring are based on Honolulu Market sampling and dockside vessel counts. The number of trips are raised to account for days which were not sampled.

Interpretation: The number of active longliners decreased by 27 vessels in 1991. Longline effort increased by 119 trips (up 8%) in 1991. The number of active longline vessels has increased from 37 vessels in 1987, and peaked at 138 vessels in 1990. The number of trips has more than tripled since 1987.

Figure 9. Hawaii's longline landings and revenue: 1987-91.

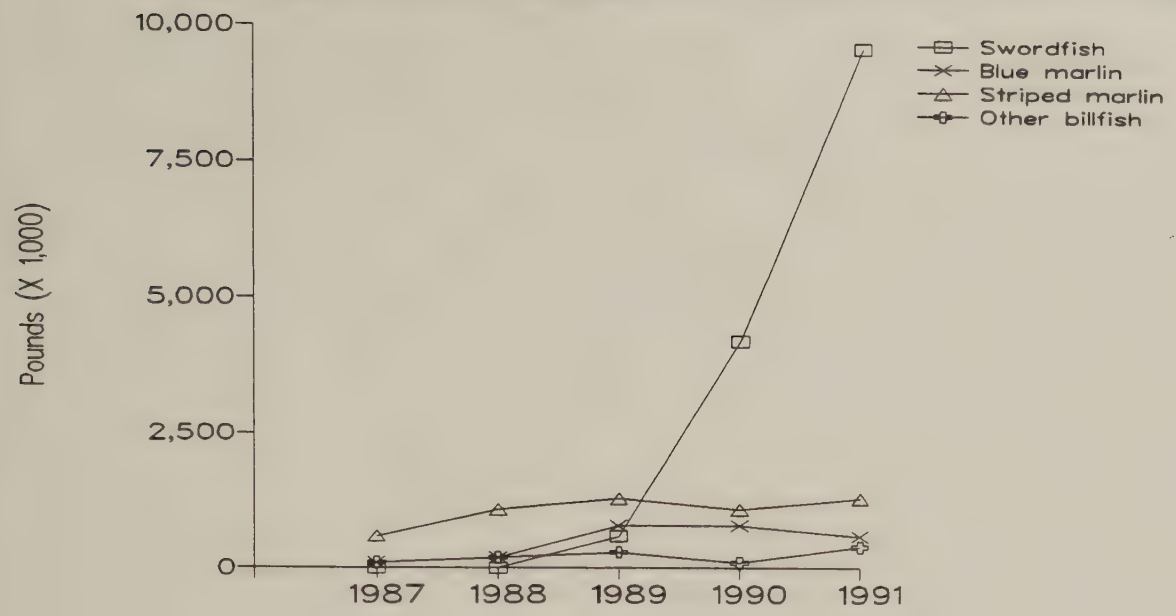


Year	Pounds (x 1000)	Revenue (x $1000)	
		Nominal	Inflation-adjusted
1987	3,800	10,300	13,300
1988	6,600	15,900	19,400
1989	9,900	21,100	24,900
1990	12,800	30,900	34,000
1991	19,000	42,700	42,700
Average	10,400	24,200	28,000

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Longline landings increased 48% in weight and 38% in revenue from 1990. The figure shows a five fold increase in landings and over a four fold increase in revenue over the 5-year period.

Figure 10. Hawaii longline landings of billfish: 1987-91.



Year	Pounds Landed (x 1000)			
	Swordfish	Striped Marlin	Blue Marlin	Other Billfish
1987	0	600	100	100
1988	0	1,100	200	200
1989	600	1,300	800	300
1990	4,200	1,100	800	100
1991	9,600	1,300	600	400
Average	2,900	1,100	500	200

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Longline landings of swordfish showed the largest increase. Swordfish landings increased to 9.6 million lb in 1991. Longline landings of striped marlin increased 18% while blue marlin decreased 25%. Other billfish (shortnosed spearfish, black marlin, and sailfish) increased substantially in 1991 (up 300%). Longline landings of swordfish increased from negligible amounts in 1987 to 9.6 million lb in 1991. Striped marlin and other billfish landings show peaks 1989 and 1991. Longline landings of blue marlin peaked in 1989-90 and declined in 1991.

Almost all longline vessel operators were familiar with techniques used to target swordfish in 1991. Longline vessels that moved to Hawaii from the east coast and Gulf of Mexico have also contributed to the increased landings of swordfish.

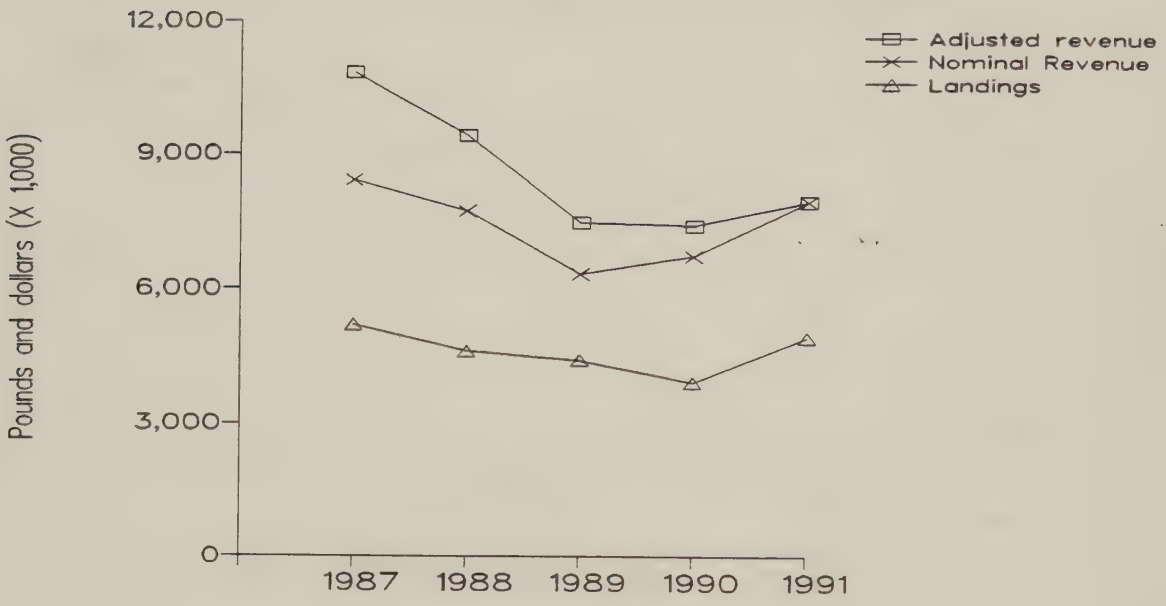
Figure 11. Hawaii longline landings of tunas: 1987-91.

Year	Pounds Landed (x 1000)		
	Bigeye	Yellowfin	Albacore
1987	1,800	600	300
1988	2,700	1,300	700
1989	3,100	2,200	600
1990	3,000	2,200	400
1991	3,400	1,600	700
Average	2,800	1,600	500

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Longline landings of bigeye increased 13% while yellowfin tuna decreased 27%. Albacore landings increased 75% in 1991. Bigeye tuna landings have increased 89% while yellowfin tuna landings have increased a factor of 3.7 from 1987-90, and showed a marked decrease in 1991. Albacore landings decreased 43% from 1988 to 1990, and increased in 1991.

Figure 12. Hawaii troll and handline landings and revenue: 1987-91.

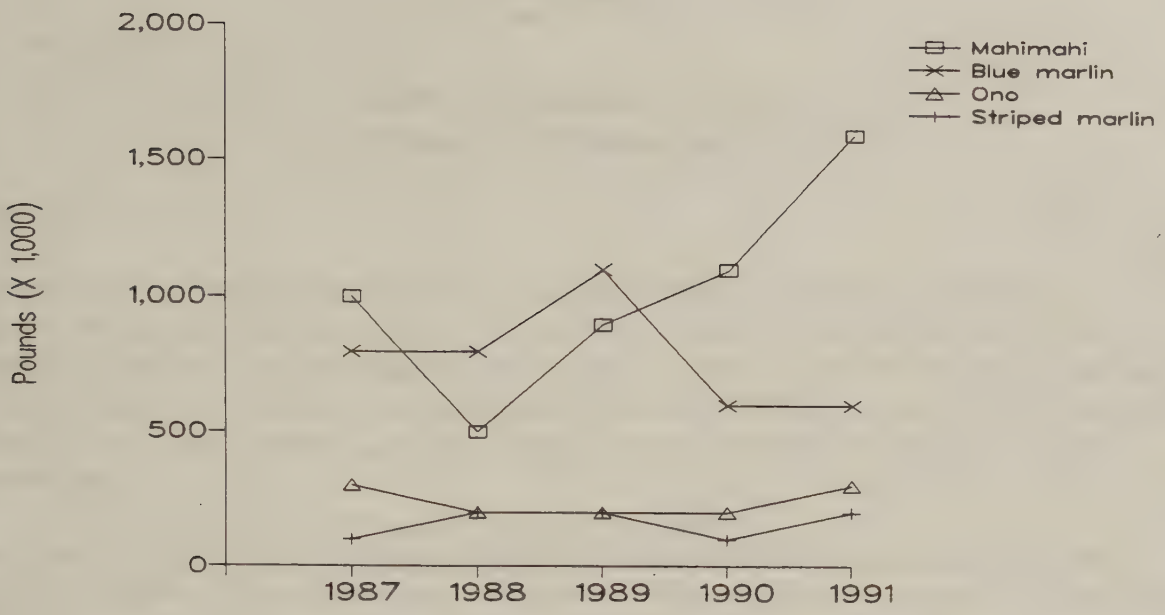


Year	Pounds (x 1000)	Revenue (x $1000)	
		Nominal	Inflation-adjusted
1987	5,200	8,400	10,800
1988	4,600	7,700	9,400
1989	4,400	6,300	7,400
1990	3,900	6,700	7,400
1991	4,900	7,900	7,900
Average	4,600	7,400	8,600

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Troll and handline landings increased 26% in weight and 18% in revenue from 1990. The figure shows troll and handline landings decreasing from 1987-90 and increasing in 1991.

Figure 13. Hawaii troll and handline landings of PMUS: 1987-91.

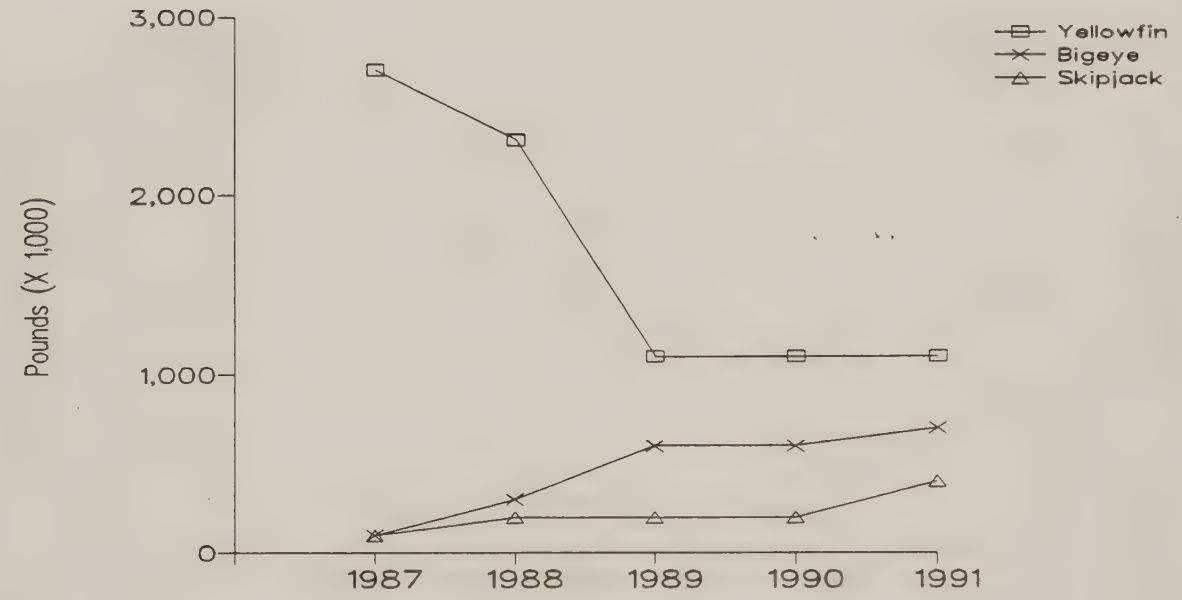


Year	Pounds Landed (x 1000)			
	Mahimahi	Blue Marlin	Wahoo (ono)	Striped marlin
1987	1,000	800	300	100
1988	500	800	200	200
1989	900	1,100	200	200
1990	1,100	600	200	100
1991	1,600	600	300	200
Average	1,000	800	200	200

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Troll and handline landings of mahimahi showed the largest increase. Mahimahi landings increased 45% in 1991. Blue marlin landings remained the same while wahoo and striped marlin landings increased in 1991.

Figure 14. Hawaii troll and handline landings of tunas: 1987-91.



Year	Pounds Landed (x 1000)		
	Yellowfin	Bigeye	Skipjack
1987	2,700	100	100
1988	2,300	300	200
1989	1,100	600	200
1990	1,100	600	200
1991	1,100	700	300
Average	1,700	500	200

Source and Calculation: Landings data are collected by the NMFS and HDAR market monitoring program. See notes to Table 1 for estimation procedures. Estimates are rounded to the nearest 100,000 lb. The numbers may not add up due to rounding.

Interpretation: Troll and handline yellowfin tuna landings remained the same in 1991. Bigeye and skipjack tuna landings increased 17% and 50% respectively in 1991. Troll and handline yellowfin tuna landings decreased 59% from 1987 to 1989, but have remained the same from 1989-91. Bigeye tuna landings increased steadily during the 5-year period. Skipjack tuna landings averaged 200,000 lb during 1987-91.

Appendix 4

State of Hawaii - Part B

(includes non-longline gear only)

Introduction

The staff of the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources (DAR) produced this report on the non-longline Hawaii pelagic fisheries. For the first time, data for the current calendar year (1991) are presented in the DAR report. The improved timeliness of the DAR data is largely due to increased efforts by the DAR Statistics Unit staff, and to improvements in data processing procedures.

The DAR summaries are produced from the State's mandatory commercial catch reporting system. Every fisherman who sells fish is required to have a Commercial Marine License and, unless specifically exempted, is required to submit a monthly catch and effort report to the DAR. A total of 4,044 fishermen were licensed in fiscal year 1991 (July 1990 to June 1991), and 2,700 of these were required to submit reports[1]. Of those fishermen required to submit reports, about 90% furnished six or more reports (12 are required by law). Some of the statistics in this report may change if additional information is received from delinquent catch reports.

Fishermen are required to report the area where they made their catches using a series of DAR Fisheries Statistical Charts, and these summaries reflect recent changes to the charts. The charts previously contained one chart for the Main Hawaiian Islands (unchanged since 1947) and a more recent Northwestern Hawaiian Islands chart (designed in the early 1980s). In July 1990, a new set of charts replaced those older versions, and a new set of area codes (grid numbers) were established for areas that were not covered by the old charts. This was done to accommodate fishermen who were fishing beyond the boundaries of the old charts. The data presented here include information from areas on the new charts, i.e., the entire Hawaiian Archipelago.

The DAR does not collect recreational fish catch and effort data. No authority or mechanism exists to do so (recreational fishermen are not required to obtain permits, and no routine creel surveys of recreational fishing are conducted). In 1990-91, however, the WPRFMC requested the DAR to supervise a one-time survey of small-boat commercial and recreational fishermen at ports around the island of Oahu. The data from this survey are now being analyzed by the NMFS Honolulu Laboratory.

---

[1] Some fishermen are not required to submit reports because they are crew members of vessels that are represented by another person, usually the captain.

The lack of data from recreational fishermen, combined with misreporting or non-reporting by some commercial fishermen, remain serious obstacles to the proper evaluation and management of Hawaii's fisheries.

Summary

There have been dramatic changes in troll and handline catch rates of yellowfin tuna, but determining the cause and significance of these changes requires further study.

The troll and baitboat catch rates for skipjack tuna reached an all-time high in 1991.

Catch rates for mahimahi also reached a new high for trolling, and almost matched the 1987 peak for handline gear.

The longline fishery changed from being predominantly a yellowfin tuna fishery to predominantly a swordfish fishery in 1991. Longline success for yellowfin tuna was relatively poor in 1991, but swordfish catches were good. Longline fishermen may have taken more sharks than were reported (this may be true for other gear types, as well), and an undetermined amount of shark-finning may also have occurred.

Some handline fishermen noted that their offshore (>20 miles) catches increased dramatically in 1991. Some fishermen noted that landings in Hilo were the best since 1982. Fishermen also noted that, although fish were abundant at their fishing grounds, they were traveling farther to find fish.

In addition to DAR monthly reports, the NMFS also collects data from the longline fleet through federal logbooks. The NMFS recognized that the DAR in 1991 covered up to 80% of the longline fleet's landings, a huge improvement over previous years. Despite this improvement, NMFS longline data is still considered preferable to the DAR's because the more-detailed federal logbook better characterizes the significant recent changes in longline fishing (e.g., in gear quantity, technology, efficiency and targeting). Longline information is presented in Appendix 3.

The NMFS also noted that the DAR data for trolling and handline fishing appears adequate for monitoring purposes, but the NMFS will continue to sample landings for size-frequency assessments. The NMFS points out that, whether using the DAR logbook data or the NMFS sampled data, an independent survey is necessary to estimate the coverage of the existing data sets.

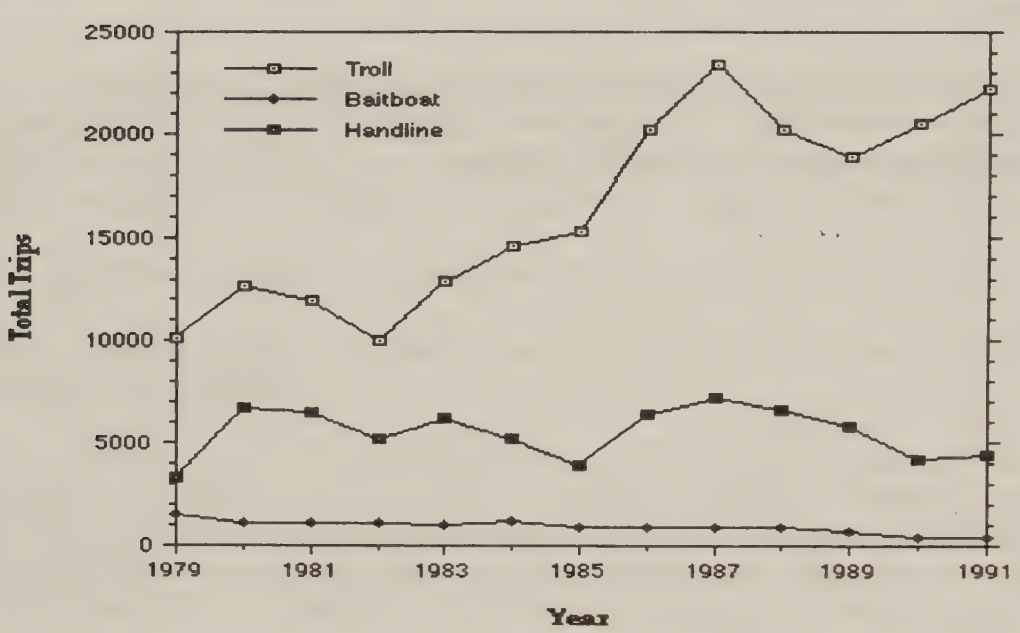
Recommendations

- The Council should continue efforts to collect data from recreational fisheries, including extending the small-boat creel survey to cover the entire state.

- The Council should commission a study of the problem of trollers and handliners catching small tunas. The study should determine the effects of catching immature yellowfin and bigeye tuna on local fish populations and markets.

- The Council should encourage the development of a tagging program, especially on small tunas. This study would help the Council characterize the interactions among various pelagic fisheries.

Figure 1. Number of trips by non-longline gear type.

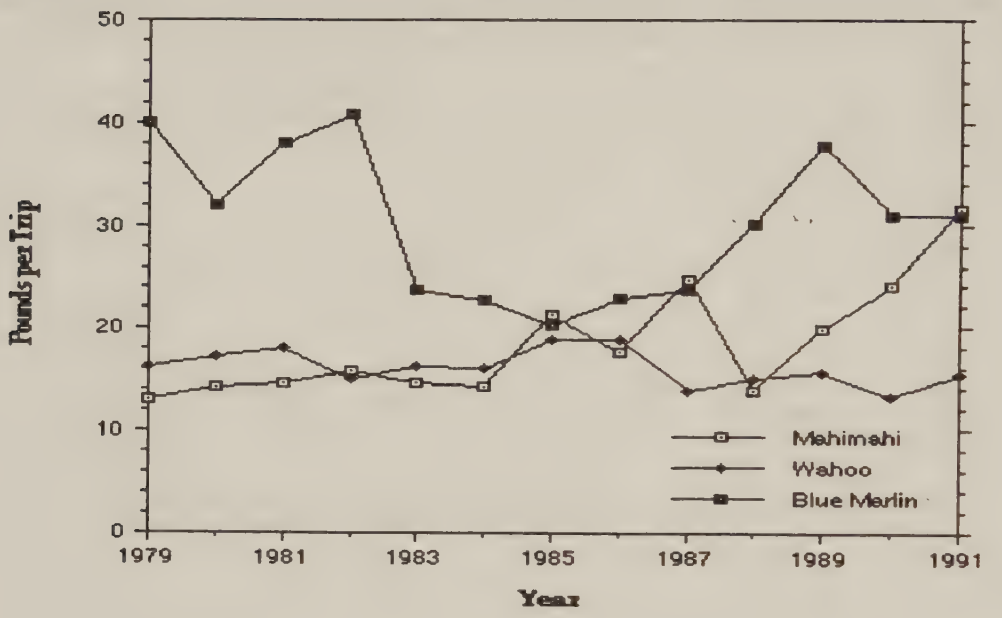


Year	Number of Trips		
	Troll	Baitboat	Handline
1979	10,185	1,495	3,346
1980	12,692	1,149	6,746
1981	11,975	1,059	6,562
1982	10,039	1,067	5,219
1983	12,842	1,014	6,275
1984	14,556	1,232	5,248
1985	15,291	924	3,929
1986	20,139	941	6,412
1987	23,391	938	7,263
1988	20,202	941	6,647
1989	18,924	723	5,834
1990	20,468	378	4,261
1991	22,224	451	4,394

Source and Calculation: DAR Commercial Catch Reports for calendar years. One trip is a day fished for a pelagic species by a fisherman, i.e., daily trips are assumed. All trips using handline gear were combined into the handline trip total. Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen, and were not processed by the DAR prior to 1989.

Interpretation: Reported trolling trips have doubled since 1979, with a rapid increase in the mid-1980s. Baitboat trips have decreased by about 70%, beginning about the time the Honolulu tuna cannery closed in 1984. Combined handline trips show no trend, with peaks in 1980, 1983, and 1987. Longline trips are not shown because of known deficiencies in reporting in recent years. Longline data are presented in Appendix 3.

Figure 2a. Catch per trolling trip: mahimahi, wahoo and blue marlin.



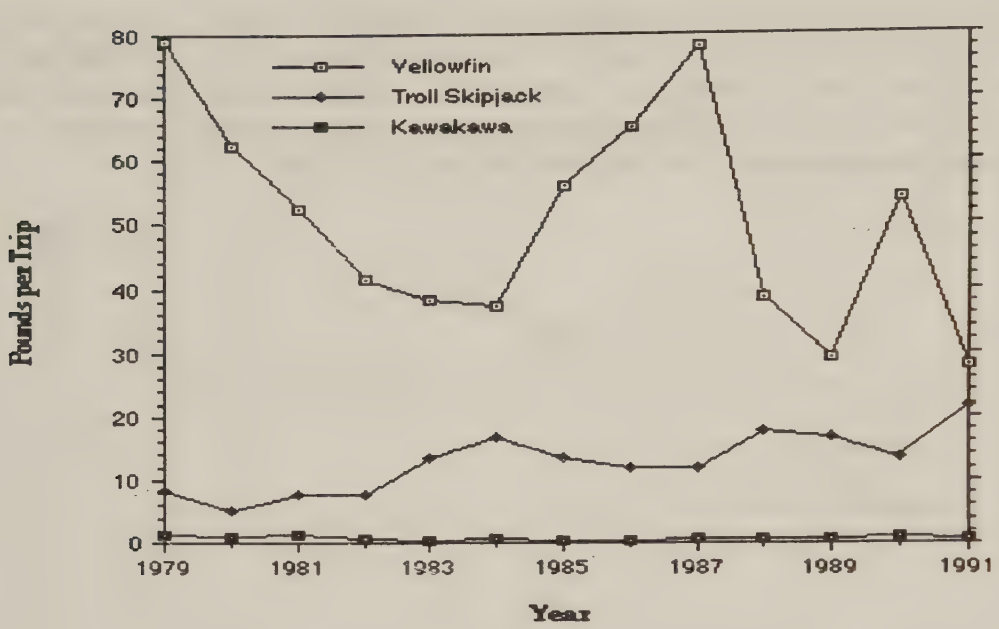
Year	Pounds Caught per Trip		
	Mahimahi	Wahoo	Blue Marlin
1979	13.0	16.3	39.9
1980	14.2	17.3	32.0
1981	14.6	18.0	37.9
1982	15.8	15.1	40.8
1983	14.7	16.3	23.8
1984	14.3	16.1	22.7
1985	21.3	18.8	20.3
1986	17.7	18.8	22.9
1987	24.7	13.8	23.7
1988	13.8	15.1	30.1
1989	19.8	15.6	37.7
1990	24.0	13.2	30.9
1991	31.6	15.4	31.0

Source and Calculation: DAR Commercial Catch Reports for calendar years. Catch per trip (CPT) was estimated by dividing the annual troll landings of each major species by the annual number of troll trips that caught any PMUS or tuna.

Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen, and were not processed by the DAR prior to 1989.

Interpretation: Blue marlin CPT showed a broad depression from 1983 to 1987, but rose rapidly to pre-1983 levels in 1988-89. The CPT dropped again in 1990-1991, but still remained higher than in 1983-87. Wahoo CPT remained nearly constant over the entire period, while mahimahi CPT showed a steep increase in 1990 and 1991, reaching a level almost double the average CPT of 1979-1989.

Figure 2b. Catch per trolling trip: yellowfin, skipjack and kawakawa.



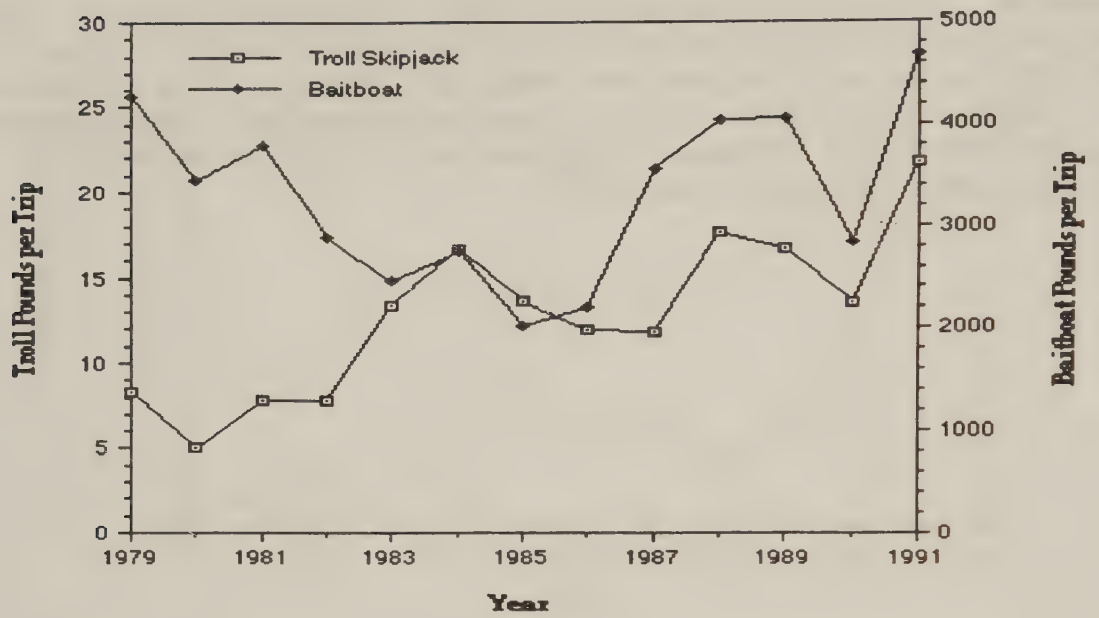
Year	Pounds Caught per Trip		
	Yellowfin	Skipjack	Kawakawa
1979	79.0	8.3	1.4
1980	62.5	5.1	1.0
1981	52.5	7.8	1.1
1982	41.3	7.8	0.7
1983	38.3	13.4	0.3
1984	37.2	16.6	0.8
1985	55.9	13.6	0.3
1986	65.1	11.9	0.3
1987	78.1	11.8	0.8
1988	38.7	17.6	0.8
1989	29.2	16.6	0.7
1990	53.9	13.4	0.8
1991	27.9	21.7	0.5

Source and Calculation: DAR Commercial Catch Reports for calendar years. Catch per trip (CPT) was estimated by dividing the annual troll landings of each major species by the annual number of troll trips that caught any PMUS or tuna.

Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen, and were not processed by the DAR prior to 1989.

Interpretation: Yellowfin CPT has fluctuated widely, decreasing sharply from 1979 to 1984, rising steeply to 1987, and decreasing in 1989 to below 1984's low catch rate. The 1990 yellowfin CPT rose to 1985 levels, but dropped again to a record low in 1991. Skipjack CPT showed a rising trend for the entire period, while kawakawa CPT declined about 50%. For reasons unknown, the low points in yellowfin CPT correspond roughly with peaks in skipjack CPT.

Figure 3. Skipjack catch per trip: troll and baitboat.



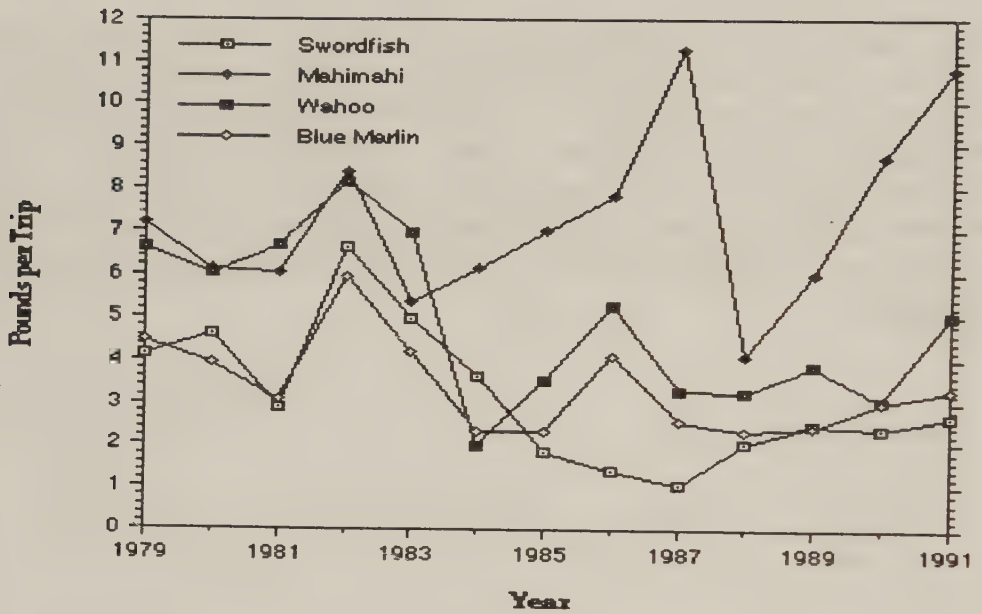
Year	Skipjack Catch per Trip (lb)	
	Troll	Baitboat
1979	8.3	4278
1980	5.1	3447
1981	7.8	3786
1982	7.8	2892
1983	13.4	2468
1984	16.6	2748
1985	13.6	2031
1986	11.9	2206
1987	11.8	3548
1988	17.6	4036
1989	16.6	4061
1990	13.4	2840
1991	21.7	4671

Source and Calculation: DAR Commercial Catch Reports for calendar years. Catch per trip (CPT) was estimated by dividing the annual troll or baitboat landings of skipjack tuna by the annual number of troll or baitboat trips that caught any PMUS or

tuna. Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen, and were not processed by the DAR prior to 1989. Troll catch rates of skipjack tuna do not include skipjack caught and used as live bait.

Interpretation: There was a broad depression in the baitboat catch rates during the early 1980s, a dip in 1990, and a record high in 1991. Market forces (cannery closing in 1984) and other causes (reduced availability of preferred natural bait types) may have affected baitboat CPT in the mid-1980s. Troll CPT also reached a record high in 1991. The similarity in trends between troll and baitboat CPT since 1986 may be due to the dramatically-reduced baitboat fleet working mainly around Oahu, where most of the trolling fleet is located, or may be related to the availability of skipjack tuna near the islands.

Figure 4a. Combined handline catch per trip: important PMUS.



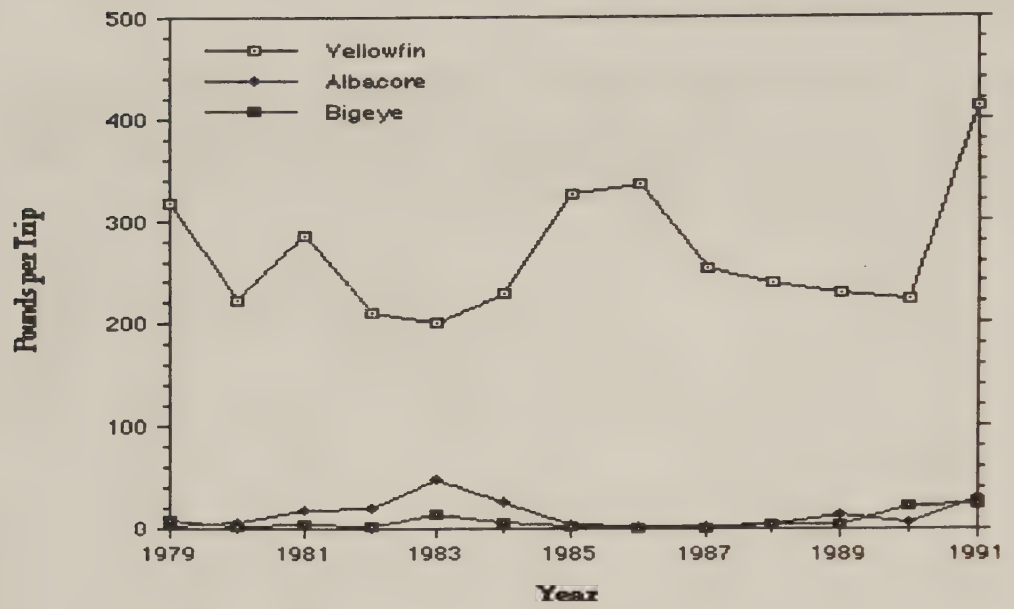
Year	Combined Handline Catch per Trip (lb)			
	Swordfish	Mahimahi	Wahoo	Blue Marlin
1979	4.1	7.2	6.6	4.5
1980	4.6	6.1	6.0	4.0
1981	2.9	6.0	6.7	3.1
1982	6.6	8.4	8.1	5.9
1983	5.0	5.3	6.9	4.2
1984	3.6	6.1	2.0	2.3
1985	1.8	7.0	3.5	2.3
1986	1.4	7.8	5.2	4.1
1987	1.1	11.3	3.3	2.5
1988	2.0	4.1	3.2	2.3
1989	2.4	6.0	3.8	2.4
1990	2.3	8.7	3.0	3.0
1991	2.6	10.8	5.0	3.3

Source and Calculation: DAR Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) calculated by dividing the annual handline landings of each major species by the annual number of handline trips that caught any PMUS or

tuna. Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen and were not processed prior to 1989. Only major PMUS caught by handline are shown here.

Interpretation: Except for swordfish, the three major handline PMUS show peaks in CPT in 1982 and in 1986 or 1987. Mahimahi CPT rises to a record peak in 1987, drops to a new low in 1988, then rises to a peak in 1991 almost matching 1987. The CPT for all species increased between 1989 and 1991.

Figure 4b. Combined handline catch per trip: important tunas.



Year	Combined Handline Catch per Trip (lb)		
	Yellowfin	Albacore	Bigeye
1979	318.1	2.6	7.8
1980	222.4	5.0	2.3
1981	284.5	18.6	3.3
1982	210.5	20.5	1.6
1983	201.2	47.6	13.1
1984	228.6	26.7	5.6
1985	326.0	3.1	2.6
1986	334.9	1.8	0.4
1987	252.9	1.8	0.9
1988	238.4	3.7	4.9
1989	229.2	13.4	3.3
1990	223.2	7.0	22.7
1991	411.2	30.9	24.3

Source and Calculation: DAR Commercial Catch Reports for calendar years. Catch per trip (CPT) was estimated by dividing the annual handline landings of each major species by the annual number of handline trips that caught any PMUS or tuna.

Unsuccessful (no-catch) trips are not included; such data generally have not been reported by fishermen, and were not processed by the DAR prior to 1989. Only major PMUS caught by handlines are shown.

Interpretation: Bigeye catch per trip may be underestimated due to reporting of bigeye as "bluefin" tuna, or as yellowfin. Due to the relative volume of landings, however, the resulting errors in the yellowfin statistics are probably small. Yellowfin CPT dropped about the same time that CPTs for the PMUS rose to a peak in 1982. Albacore and bigeye rose while yellowfin was depressed, and then were low again when yellowfin peaked in 1985-1986. By 1987, yellowfin CPT declined and shows a gentle decline through 1990, and then showed a remarkable rise to a 12-year high in 1991.

Appendix 5

Commonwealth of the Northern Mariana Islands

Introduction

The Northern Marianas pelagic fishery occurs primarily surrounding the islands of Saipan, Tinian, Rota, and Aguigan. This report, however, will be limited to the catches landed in Saipan, which is by far the largest market. The fishery will be characterized by data collected through the Commercial Purchase Data Base which indirectly records actual landings by recording all local fish sales to commercial establishments. This data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Staff from the Department of Natural Resources, Division of Fish and Wildlife (DFW) routinely collect and distribute invoice books to more than 50 participating local fish purchasers. These which includes practically all fish markets, stores, restaurants, hotels and roadside vendors ("fish-mobiles"). Although this data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be comparable for most aspects of the fisheries.

Although this database lacks information concerning fishing methodology, location and fishing effort, the Offshore Port Sampling Survey provides the additional data required for further analysis. The Offshore Port Sampling Program has recently been improved through the hiring of two additional personnel, data sheet modification and an increase in effort with respect to field sampling. The NMFS Honolulu Lab personnel are presently finalizing the computer software programs necessary to calculate an estimate of total landings and effort by method. Historical port sampling data is presently being entered into the computer.

Summary

Trolling is the primary fishing method utilized for the pelagic fishery. A longlining venture, the only exception, was attempted by the US vessel F/V SUN which operated from March to October 1990. Fishing success was limited with less than 12 fishing trips completed. The catch revenue for the majority of trips did not cover fuel and wage expenses. Two other domestic longline vessels appeared in Saipan during 1991, however, no fish were landed. Although not formally introduced to the local fishermen, Ika Shibi fishing was experimentally tested in Northern Marianas waters during 1989 by a DFW consultant.

The pelagic fishing fleet, other than charter boats, consist primarily of vessels less than 24 feet in length and usually has a limited 20-mile travel radius from Saipan. Approximately 79% of all registered boats participated in some form of fishing activity. With respect to full time commercial fishing, 52 vessels were identified, whereas 89 vessels were classified as part-time commercial fishing. Subsistence and/or recreational fishing included 211 vessels. Fishing trips are generally restricted during the daylight hours with all vessels returning before or soon after sunset.

With the recent addition of three large vessels to the charter fishing fleet by the Daiwa Leisure Fishing Company, charter fishing will most likely become more competitive. In 1991, 27 vessels were registered with the Boating Safety Office as charter fisherman in 1991, although only approximately 10 vessels operate a bona fide charter fishing operation. It is general practice for the charter vessel to retain the daily catch and sell at least half to local markets. The magnitude of charter boat sales are unknown, however at this time, it is believed that the local market can absorb the catch without impacting the commercial fisherman.

The primary target species for the pelagic fleet is the skipjack tuna and mahimahi. During their seasonal runs, these fish inundate nearshore waters and provide easy targets for the local fisherman. In addition to the economic advantage of being nearshore and relative ease of capture, these two species are widely accepted by all ethnic groups and market demand usually remains high due to the recent population growth experienced on Saipan. All factors combined, the skipjack tuna and mahimahi provide the local fisherman an appealing and appropriate target species.

Recommendations

- The Northern Mariana Islands report could be improved by the addition of standard fisheries data such as length-frequency analyses and seasonality distributions.

Table 1.
CNMI 1991 commercial pelagic landings, revenues and price per pound (prices are not adjusted for inflation).

Species	Pounds	Revenue ($)	$/lb
Mahimahi	26,792	50,337	1.88
Blue Marlin	1,320	2,223	1.68
Sailfish	105	263	2.50
Wahoo	1,182	3,091	2.62
Subtotal PMUS	**29,398**	**55,914**	**1.90**
Dogtooth Tuna	1,653	3,727	2.25
Skipjack Tuna	92,009	160,008	1.74
Yellowfin Tuna	10,381	24,623	2.37
Subtotal Tunas	**104,043**	**188,358**	**n/a**
Troll-caught fish	16,315	24,807	1.52
Rainbow Runner	165	415	2.51
Barracuda	40	90	2.25
Total Pelagics	**149,962**	**269,584**	**1.80**

Calculation: Annual summaries for each species from invoice data sheets.

Note: Landings estimates from the 1991 Commercial Purchase Data Base was under-estimated, and is presently being re-evaluated in an attempt to generate a better estimate of total landings. There are presently more than 50 participating local fish purchasers compared to the approximate 20 that were collected during 1991. Even with low participation in 1991, those 20 vendors purchased most of the locally-caught fish.

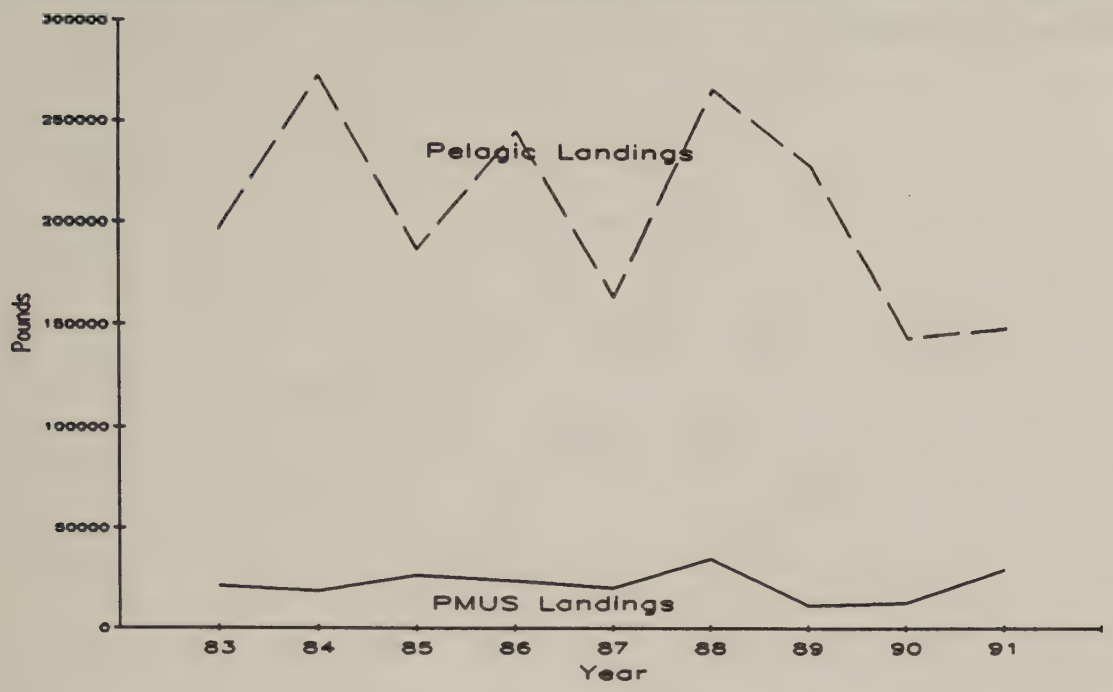
Interpretation: The 1991 pelagic fishery landings were dominated by skipjack tuna, mahimahi and yellowfin tuna; which comprised 97% of the known species landings. Skipjack tuna, a non-PMUS, continued to lead landing statistics in both landings and revenue for 1991. Schools of skipjack tuna can become ubiquitous in nearshore waters, thus providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. In addition, this species is also readily consumed by the indigenous population.

Of the PMUS, mahimahi dominated the landing statistics in both landings and revenue. Schools of mahimahi, like skipjack tuna, are also easily caught in nearshore waters. Mahimahi, however, are highly seasonal, with peak landings in 1991 during January-March.

Although skipjack tuna received the second lowest price per pound, this species generated over 50% of the total pelagic fishery revenues for 1991. Yellowfin and dogtooth tunas both commanded respectable prices; yellowfin tuna are in demand with the restaurant trade, while dogtooth tuna are primarily consumed by the indigenous population. Not surprisingly, 96% of the total known species revenues are from skipjack tuna, mahimahi and yellowfin tuna sales.

Blue marlin brought the lowest price. This species is taken primarily by charterboat fishermen, as well as other fishermen during the annual Saipan International Fishing Tournament. Although blue marlin sashimi is sold in restaurants, the low price could be partly related to the manner which the fish is kept prior to sale and the bulky size. These large fish (relative to the other pelagic species caught) are generally not iced and, therefore, are usually of lower quality at the time of sale. In addition, fishermen usually wish to sell the whole fish to avoid cleaning and repackaging the fish into smaller units for sale to local restaurants.

Figure 1. CNMI annual commercial landings: all pelagics and PMUS.



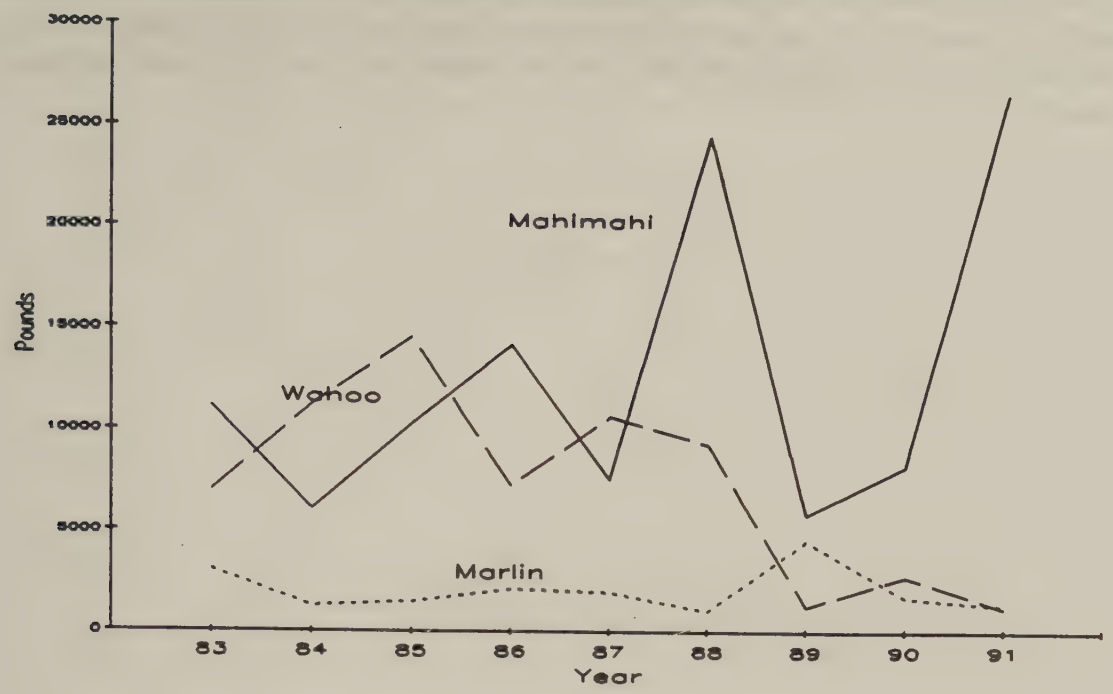
Year	Pounds Landed	
	All Pelagics	PMUS
1983	196,788	21,236
1984	272,909	18,595
1985	187,378	26,514
1986	245,967	23,701
1987	164,055	20,360
1988	267,619	35,044
1989	229,427	11,676
1990	144,862	12,823
1991	149,962	29,398

Source and Calculation: Total pelagic and PMUS landings are summed from the Commercial Purchase Data Base.

Interpretation: Historic pelagic landings display an alternating high/low trend, however, for the last two years no substantial increase is noted. The 1990-91 decline in pelagic landings correlates with the corresponding decline in skipjack tuna landings. Because skipjack tuna comprises a substantial portion of the pelagic landings (see Table 1), any noticeable increase or decline in landings for this species (Figure 3) is also noticeable

in the total pelagic landings. PMUS landings increased in 1991 nearly to the highest historical level (in 1988). In both cases the rise in PMUS landing was attributed to the large landings of mahimahi.

Figure 2. CNMI annual commercial landings: mahimahi, wahoo, and blue marlin.



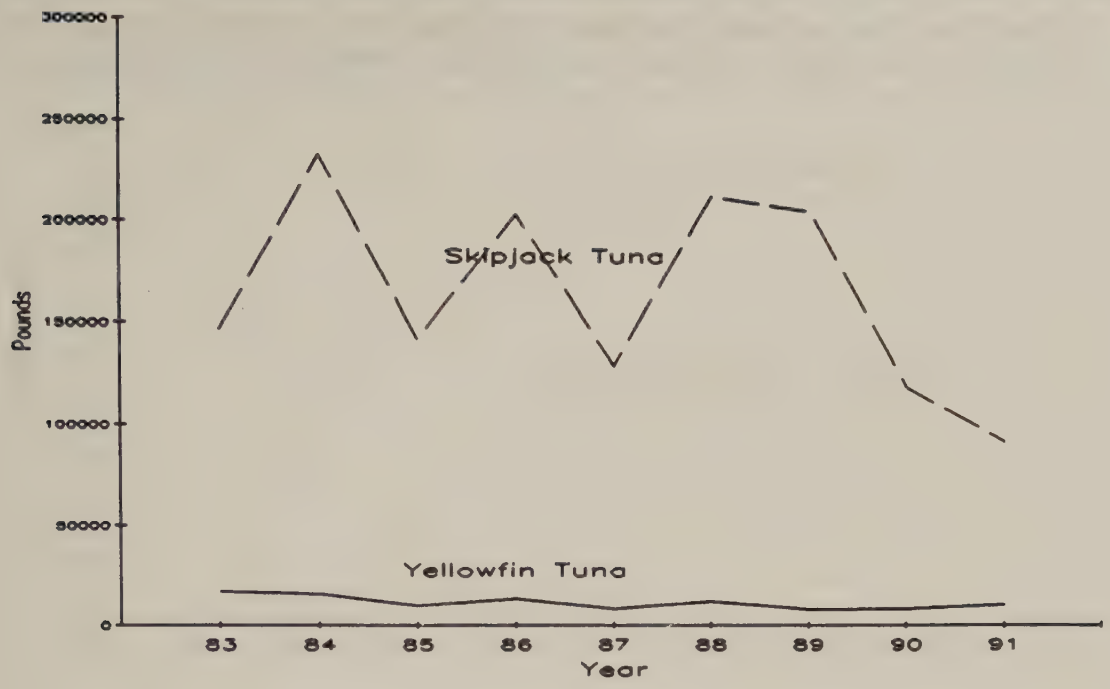
Year	Pounds Landed		
	Mahimahi	Wahoo	Blue Marlin
1983	11,151	7,008	3,030
1984	6,091	11,270	1,235
1985	10,364	14,601	1,488
1986	14,237	7,250	2,123
1987	7,602	10,723	1,968
1988	24,639	9,358	1,047
1989	5,856	1,257	4,563
1990	8,306	2,770	1,748
1991	26,792	1,182	1,320

Source and Calculation: The annual commercial landings of three major PMUS species (mahimahi, wahoo and blue marlin) are summed directly from the Commercial Purchase database.

Interpretation: Landings of mahimahi just barely surpassed the previous 1988 record high of 24,632 pounds. No explanation can be offered for the cyclic pattern of mahimahi landings.

Wahoo landings have been substantially declining since 1989 and this year reached the lowest point since 1983. From 1983 to 1988, Wahoo landings appeared to be somewhat consistent, no explanation can be offered for the sudden 1989 decrease in landings. Marlin landings have historically remained at low levels and the 1991 landings were not any different.

Figure 3. CNMI annual commercial landings: skipjack and yellowfin tuna.



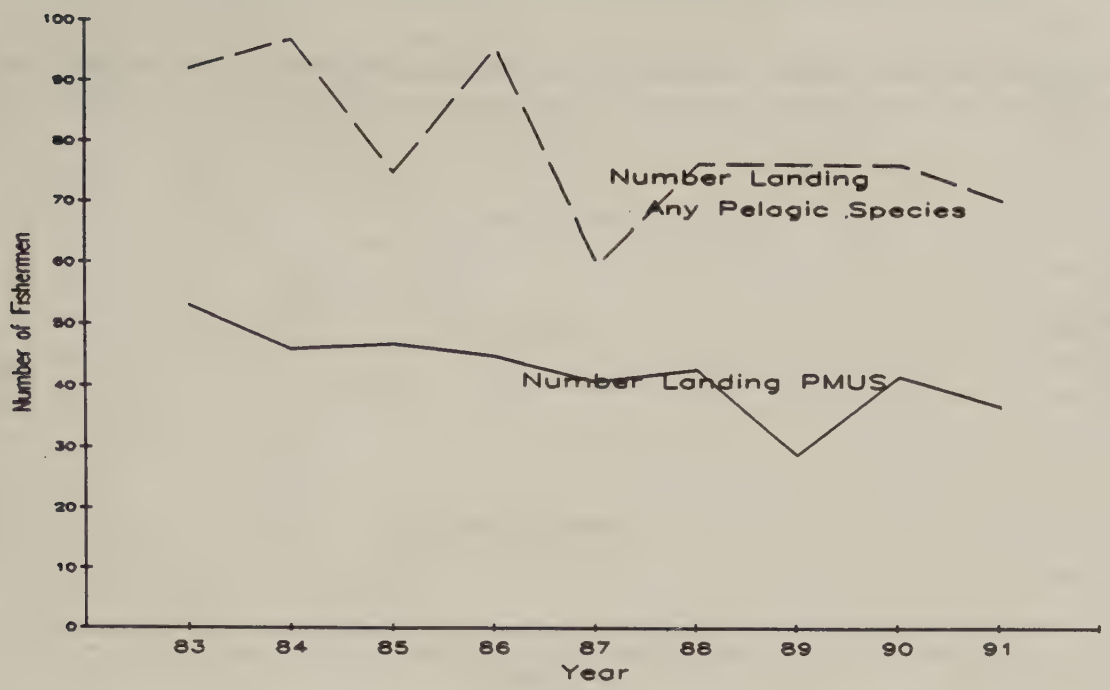
Year	Pounds Landed	
	Skipjack Tuna	Yellowfin Tuna
1983	146,729	17,025
1984	232,675	15,664
1985	141,910	9,973
1986	203,490	13,533
1987	129,203	8,363
1988	213,198	12,300
1989	206,162	8,087
1990	118,798	8,374
1991	92,009	10,381

Source and Calculation: Landings are summed directly from the Commercial Purchase Data Base.

Interpretation: Skipjack tuna landings declined substantially through 1990, and in 1991 reached their lowest levels since 1983. For the 5-year period starting in 1983, landings showed a distinct two year cycle, but landings have decreased for the last three years. We assume that relative (species) fishing effort was consistent with previous years because of the importance of skipjack tuna in the local market, as well as its preference among fishermen. The reason for the continuing decline in landings is unknown and

should be investigated from a geographical and biological perspective. Yellowfin tuna landings increased slightly from 1990, but since 1983, annual landings show no real trend. In Saipan waters, yellowfin tuna are not often taken, and the average fish size tends to be smaller compared with yellowfin tuna from other geographic areas.

Figure 4. Number of CNMI fishermen landing pelagic species and PMUS.

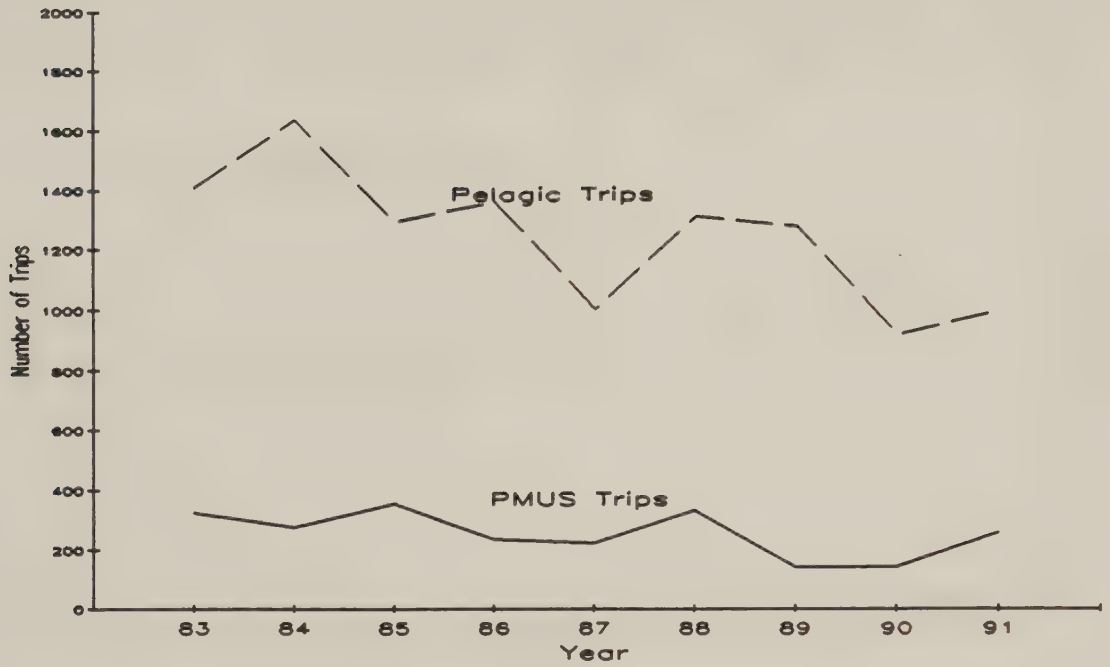


Year	Number Fishermen Landing	
	Any Pelagics	PMUS
1983	92	53
1984	97	46
1985	75	47
1986	96	45
1987	60	41
1988	77	43
1989	77	29
1990	77	42
1991	71	37

Source and Calculation: Each invoice from the Commercial Purchase Data Base records the fisherman's name from whom the fish was purchased. The number of fishermen who sold any pelagic species (including PMUS), and those who sold only PMUS are calculated directly from the data.

Interpretation: The number of fishermen landing pelagic species remained constant from 1988 to 1990. A decrease of six fisherman was noted in 1991. A similar decrease was noted for the number of fisherman landing PMUS.

Figure 5. Number of CNMI fishing trips landing pelagic species and PMUS.



Year	Number of Trips Landing	
	Any Pelagics	PMUS
1983	1,408	324
1984	1,634	276
1985	1,293	353
1986	1,356	235
1987	999	221
1988	1,306	331
1989	1,272	141
1990	910	140
1991	990	254

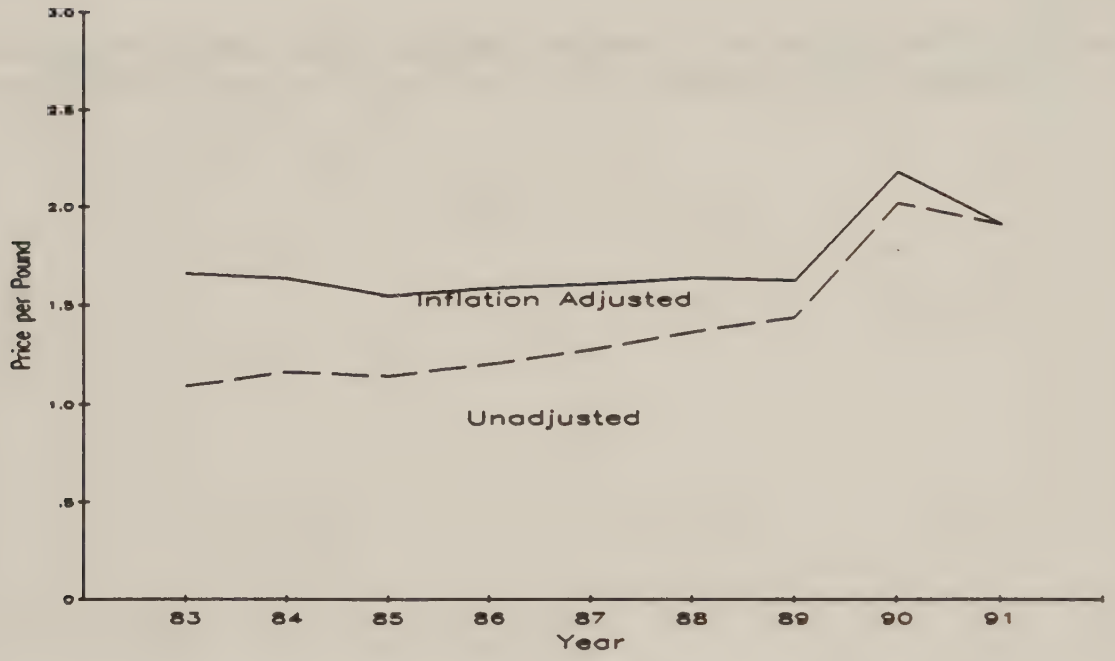
Source and Calculation: The total trips for all pelagic species and for PMUS are summed from the Commercial Purchase Data Base. Trips are calculated based on the assumptions that no fisherman makes more than one trip per day, and that all sales from a single trip are made on a single day.

Interpretation: The 1991 pelagic fishing trips increased by 80 trips from the record low of 910 trips which occurred during the previous year (1990). The general decline in number of pelagic fishing trips from 1984 is most likely a reflection of the shift from full-time fishing to part-time by many of the better fishermen. This change may be related

to more fishermen participating in the lucrative tourist market or local government positions.

The number of PMUS trips had a substantial increase which may be related to the dramatic increase in 1991 mahimahi catches, historically a dominant PMUS fishery.

Figure 6. CNMI average price of PMUS (nominal and adjusted for inflation).



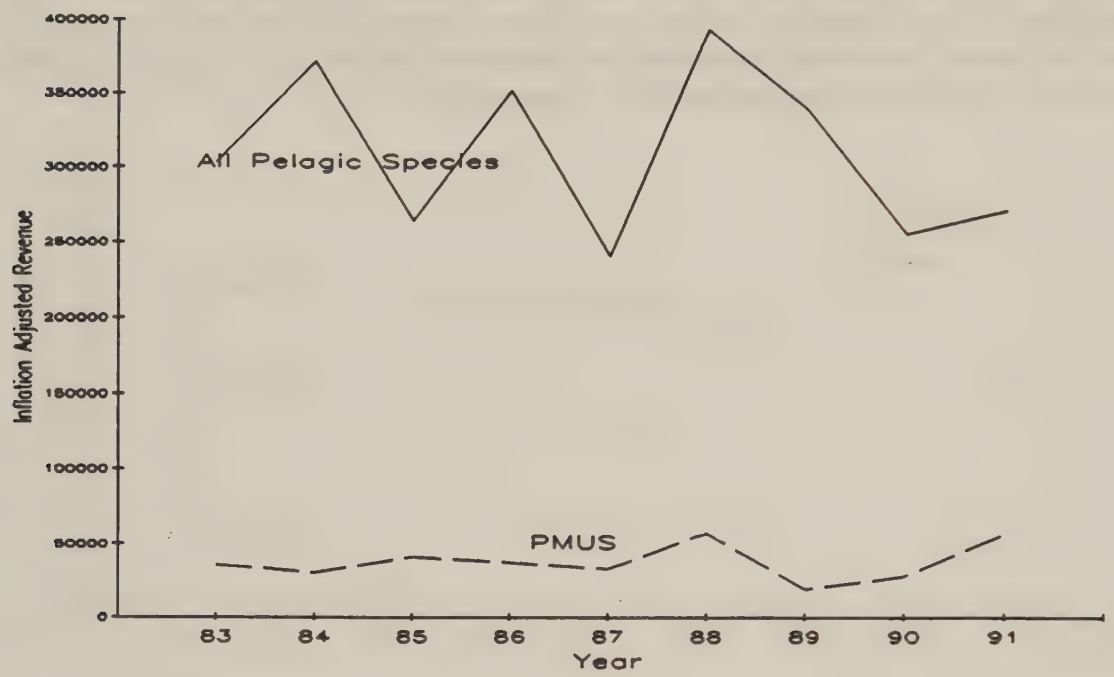
Year	Price ($/lb)	
	Unadjusted	Adjusted
1983	1.09	1.66
1984	1.16	1.63
1985	1.14	1.54
1986	1.20	1.58
1987	1.27	1.60
1988	1.36	1.63
1989	1.43	1.62
1990	2.01	2.17
1991	1.90	1.90

Source and Calculation: The unadjusted average price of PMUS is calculated by dividing the total revenues generated from PMUS by the total weight of PMUS sold. The inflation adjustment is made using the 1991 Consumer Price Index (CPI) as the basis by which calculations of previous years' prices are made. The CNMI CPI was not available for the years 1983-87, so Guam's CPI was used to back-calculate the missing CNMI values.

Interpretation: The average price for PMUS decreased in 1991 following a record high increase the previous year (1990). The high 1990 average price is most likely related to

the low PMUS landings and excellent market demand. The adjusted and unadjusted average PMUS prices prior to the dramatic 1990 increase, appear to follow a general upward trend. After adjusting prices for inflation, the prices were relatively stable until 1990 when market demand drove prices up markedly. Although prices declined slightly during 1991, market demand appears to remain high.

Figure 7. CNMI annual inflation-adjusted commercial revenues: all pelagics and PMUS.



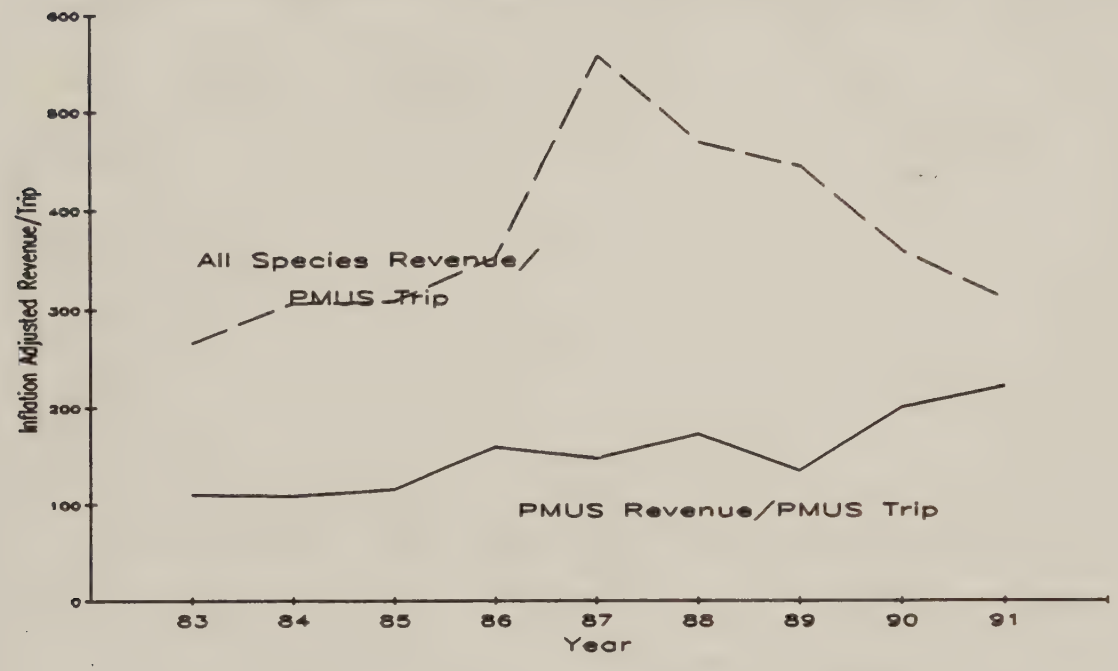
Year	Revenues ($)			
	All Pelagics		PMUS	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	198,710	303,231	23,248	35,477
1984	264,203	370,677	21,635	30,354
1985	195,372	263,752	30,306	40,913
1986	267,013	351,122	28,391	37,334
19[illegible]	190,150	239,589	25,875	32,603
198[illegible]	327,260	391,730	47,761	57,170
1989	299,142	338,030	16,733	18,909
1990	235,520	254,126	25,746	27,780
1991	269,584	269,584	55,914	55,914

Source and Calculation: Annual revenue in dollars is summed separately for all pelagic fish and PMUS only. Inflation-adjusted revenues are calculated using the Consumer Price Index, with 1991 as a base by which previous years' nominal prices are adjusted. The CNMI CPI was not available for the years 1983-1987, so Guam's CPI was used to back-calculate the missing CNMI values.

Interpretation: Inflation-adjusted revenues for all pelagic species rose only slightly in 1991, but did not approach the 1988 record high. Inflation-adjusted revenues for PMUS

increased slightly for the second consecutive year. In general, the trend for PMUS revenues appears stable, relative to the inflation-adjusted total pelagic species revenues. The erratic fluctuations of the inflation-adjusted revenues for all pelagic species is most likely due to the annual variations in skipjack tuna landings (see Figure 3).

Figure 8.
CNMI annual commercial inflation-adjusted revenues for all pelagics and PMUS, for fishing trips that caught PMUS.

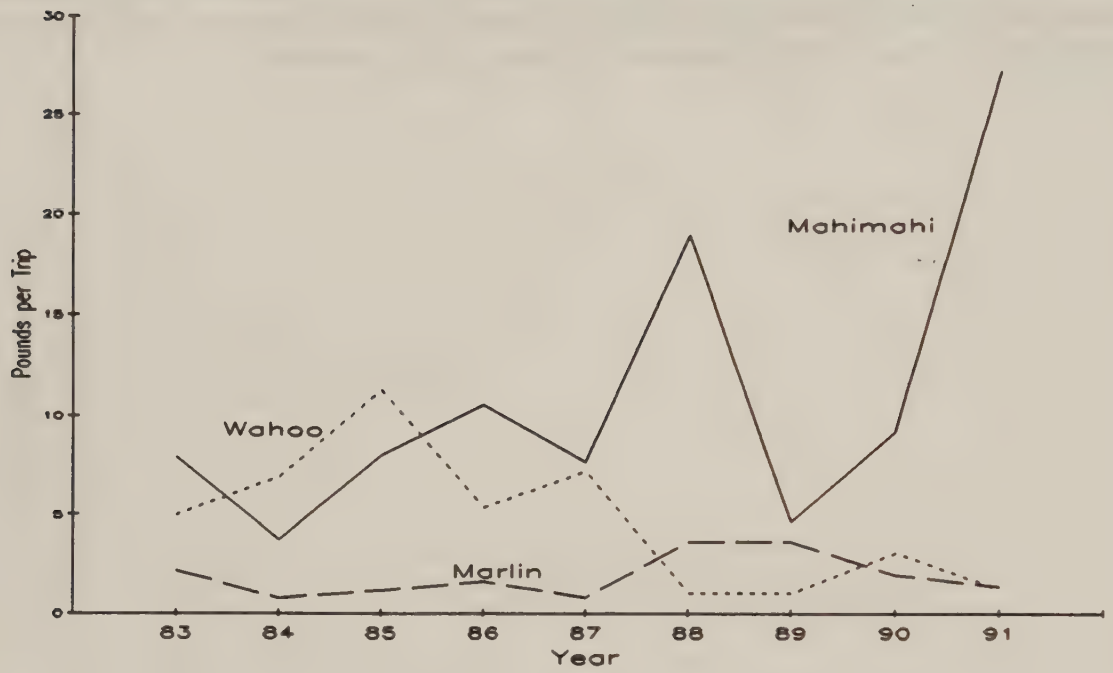


Year	Revenue per Trip Landing PMUS ($)			
	All Pelagics		PMUS	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	174	266	72	110
1984	218	306	78	109
1985	228	308	86	116
1986	268	352	121	159
1987	441	556	117	147
1988	390	467	144	172
1989	391	442	119	134
1990	330	356	184	199
1991	308	308	220	220

Source and Calculation: Values are obtained by selecting, from the Commercial Purchase Data Base, all trips which landed at least one PMUS, and then calculating (a) the average revenue of total pelagic species, and (b) the average revenue of the PMUS only. Inflation-adjusted revenues are derived from the Consumer Price Index (CPI) which used 1991 as a base. The CNMI CPI was not available for the years 1983-87, so Guam's CPI was used to back-calculate the missing CNMI values.

Interpretation: The adjusted revenues for total pelagic species per PMUS trip declined again in 1991, while the inflation-adjusted revenues for PMUS per PMUS trip have increased during the last two years. The increase in PMUS revenues may indicate an increasing importance in PMUS relative to other pelagic species.

Figure 9. CNMI trolling catch rates: mahimahi, wahoo and blue marlin.



Year	Pounds Caught per Trip		
	Mahimahi	Wahoo	Blue Marlin
1983	7.9	5.0	2.2
1984	3.7	6.9	0.8
1985	8.0	11.3	1.2
1986	10.5	5.4	1.6
1987	7.6	10.7	2.0
1988	18.9	7.2	0.8
1989	4.6	1.0	3.6
1990	9.1	3.0	1.9
1991	27.1	1.2	1.3

Source and Calculation: Annual catch rates for selected species are obtained by calculating the average weight per trip for each year. Trips are assumed to be one day in length and each invoice represents one trip.

Note: The 1987 and 1988 catch rates in the table for wahoo and blue marlin have been revised; an inadvertent error was discovered in a review of the 1990 annual report.

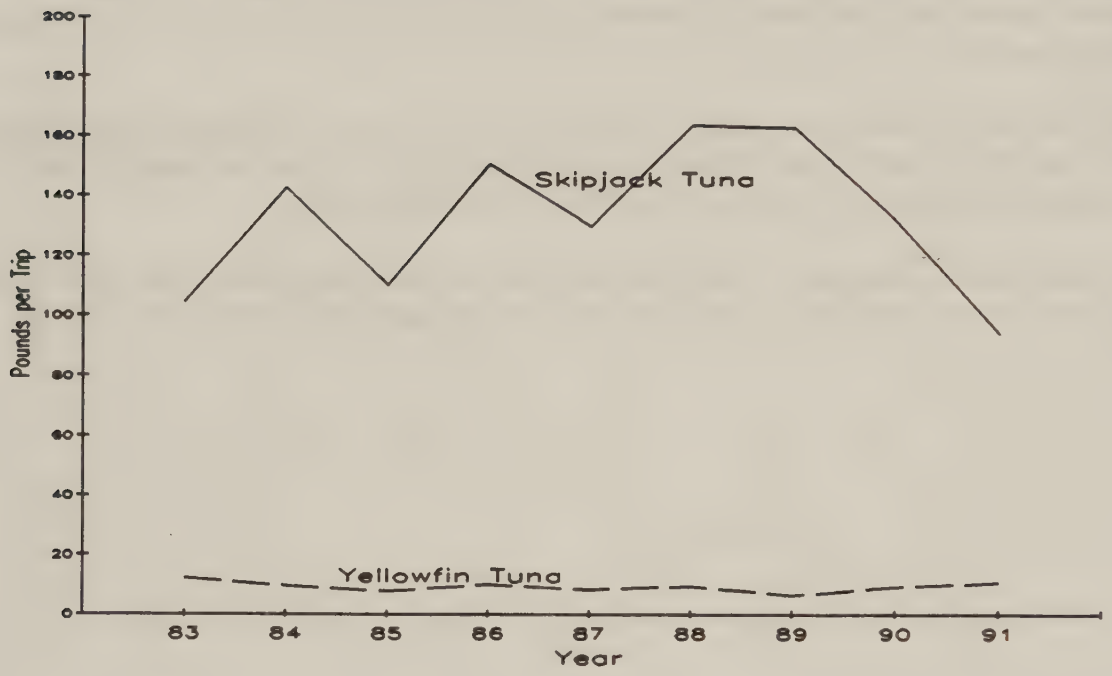
Interpretation: The 1991 catch rates for marlin and wahoo decreased, contrasting dramatically with the increase in mahimahi catch per trip which tripled from 1990 to

1991. The highest recorded catch rate of mahimahi occurred in 1991, exceeding the prior 1988 record by eight fish per trip. An annual cyclic pattern appears in the mahimahi catch rate; this pattern corresponds closely to the total annual mahimahi landings (see Fig. 2).

Relative to the pre-1988 data, wahoo catch rates have been declining for the last three years. The 1991 catch rate continued the decline after a slight increase in 1990. No explanation is offered for the general decline of wahoo landings.

Marlin catch rates, relative to mahimahi and wahoo, are historically low. The highest catch rates occurred during 1989, and have decreased each succeeding year.

Figure 10. CNMI trolling catch rates: skipjack and yellowfin tunas.



Year	Pounds Caught per Trip	
	Skipjack Tuna	Yellowfin Tuna
1983	104.2	12.1
1984	142.4	9.6
1985	109.8	7.7
1986	150.1	10.0
1987	129.3	8.4
1988	163.2	9.4
1989	162.1	6.4
1990	130.6	9.2
1991	92.9	10.5

Source and Calculation: Data are summarized from the Commercial Purchase Data Base, which provides average pounds caught per trip. Annual catch rates for selected species are obtained by calculating the average weight per trip for each year. Trips are assumed to be one day in length and each invoice represents one trip.

Interpretation: The catch rates for skipjack tuna have decreased dramatically for the last two years. Previous to the current decline, skipjack tuna had the highest recorded catch rates in 1988 and 1989. Skipjack tuna are the preferred species in the troll fishery of the CNMI because of its relative ease of capture and local popularity. The decline in

catch rates for this species parallel declines in total landings (see Fig. 3). These declines may be related to the resource (abundance or catchability) rather than the fishery; there is no apparent change in targeting of this species by local fishermen. The catch rates for yellowfin tuna have increased slightly for the past two years. From 1984-90, yellowfin catch rates had been relatively stable. Yellowfin tuna are not encountered often and are usually taken incidentally with other species.